POWER UTILITY RESTRUCTURING AND POWER-SECTOR FINANCING IN DEVELOPING COUNTRIES

By

Bikash Thapliya

B.E., Electrical and Electronics Engineering
Bharathidasan University, 1993

Submitted to the

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

in partial fulfillment of the requirements for the Degree of

Master of Science (in Technology and Policy)

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 1997

Signature of Author ....
Department of Electrical Engineering and Computer Science, June, 1997

Certified by ....
Frannie Humplick, Ph.D., Senior Economist, The World Bank
Thesis Co-advisor

Certified by ....
Richard Tabors, Ph.D., Senior Lecturer, Technology, Management and Policy
Thesis Co-advisor

Certified by ....
Richard de Neufville, Ph.D., Professor of Civil and Environmental Engineering
Chairman, Technology and Policy Program

Accepted by ....
A.C. Smith, Ph.D., Chair, Department Committee on Graduate Students

TABLE OF CONTENTS

List of Tables

List of Figures

POWER UTILITY RESTRUCTURING AND POWER-SECTOR FINANCING IN DEVELOPING COUNTRIES

By
Bikash Thapliya

Submitted to the Department of Electrical Engineering and Computer Science on May 19, 1997 in partial fulfillment of the requirements for the Degree of Master of Science in Technology and Policy

ABSTRACT

The problems of dwindling investment capital, financial mismanagement; inappropriate investment policies; operational, institutional, and environmental deficiencies have forced many developing nations scrambling to search for solutions. Privatization—the transfer of ownership of state-owned assets to the private sector—has arguably been the most sought-after recipe by willing policy makers in developing countries since it swept Chile, New Zealand, and the United Kingdom in the 1980s.

This thesis argues that transfer of assets of state-owned electric utilities to the private sector is not an economic necessity *per se* if policies allowing for competitive procurement of electricity provision and the state's adherence to non-interventionism can coexist with state ownership. This argument is drawn from a model that analyzes the relationships among a country's economic and political endowments, production structure of energy service provision, operational efficiency and service quality.

In developing countries, however, the general lack of regulatory capacity and transparency in decision-making makes the latter an unforeseeable alternative. Against this backdrop, private provision of electricity becomes an imperative when the objectives are to improve both the efficiency of service provision and to attract private capital. Private ownership of divested public assets backed by competition—sufficient to challenge market power—and minimal regulation would be an ideal combination for a growing electric industry.

Attracting private investment in the power sector is the next big challenge for developing countries. This thesis argues that private capital that is devoid of country risk and project risk guarantees will always be cheaper. This would mean that project developers would have to put their balance sheets at risk. Local capital markets provide the platform for project developers to exchange their debt and equity for cash and exit the market. To examine the level of level of development of capital markets, a financial model is formulated to investigate the extent of maturity of emerging capital markets of six developing countries—Argentina, Brazil, Chile, Malaysia, Philippines, and South Korea—and its relationship with electricity stock capitalization, net foreign direct investment, and international loans. It is found that emerging capital market will depend more on international loans/bonds and foreign direct investment to expand itself. In contrast, a matured capital market would be in a position to mobilize domestic capital to finance infrastructure investments.

Power utility restructuring and private-sector financing reinforce each other. These items, therefore, need to go together in any comprehensive macroeconomic reform package that is being carried out in many parts of the world.

1. WHY RESTRUCTURE?

1.1 The Dilemma

The power systems of developing and industrial countries alike shared similar characteristics before the oil crisis of 1973-74. They were growing rapidly, and supplying power at declining real prices.[1] Improvements in system performance made by industrial countries through economies of scale and thermal efficiency would, in general, always find their ways into developing countries with some time lag. When the oil crisis struck developing country consumers and, to a large extent, utilities failed to respond. Costs escalated but real prices did not increase accordingly; social and political considerations led many governments in developing countries to reduce the impact of rising electricity prices on consumers mostly through subsidies.[2]

The pressures of rapidly increasing electricity demand and reduced cash flows ultimately led utilities to borrow heavily to finance their investments. Loans were generally taken at international financial markets where interest rates were relatively low. In the 1980s, however, the interruption of international flow of capital into developing countries and the simultaneous increase in interest rates caused by industrial countries' monetary policies forced the former to undertake large devaluations of domestic currencies. These devaluations led to increased utility debts and rendered many of them insolvent.[3]

Utilities, which were mostly state-owned, had to rely on government coffers to solve their financial difficulties. The burgeoning debt crisis, however, destroyed the financial equilibrium of most developing country public accounts: the problems that treasuries had in subsidizing utilities was compounded by the additional dilemma that

---

[1] Mason, M., Gilling, J., Munasinghe, M.; *A review of World Bank lending for electric power*, World Bank, Washington DC, 1988.

[2] Oliveira, Adilson de and MacKerron, Gordon; *Is the World Bank approach to structural reform supported by experience of electricity privatization in the UK?*, Energy Policy, February 1992.

[3] OLADE, The foreign debt of the energy sector of Latin American and the Carribean, Quito, Ecuador, 1988.

utilities absorbed huge amounts of foreign exchange but were unable to earn any. Further capital investments and maintenance expenditures were thus postponed. Financial and technological performance further deteriorated. Blackouts and brownouts collectively became a part of life for both residential and industrial consumers.[4]

1.2 **The Evidence**

Several factors contributed to the developing country's power sector to recede further into financial and institutional unviability. Huge investment capital requirements, poor financial performance through misplaced pricing policies, operational, managerial, institutional, and environmental issues are chief among them.

1.2.1 Requirements for investment capital

An investment amounting to US$1 trillion (in 1993 dollars) would be required in the decade of the nineties if developing countries are to finance investments to meet their projected demand growth of power. In terms of installed capacity, another 384 GW—equivalent to an increase in 80% above the 1989 level—would need to be added by the turn of this century. Of the direct investment needed by the utilities themselves, about US$40 billion annually would be required in foreign exchange; the other US$60 billion would have to come from domestic capital sources. Raising the latter, however, will be no easy task.[5] In most of the developing countries the local capital markets, if they exist at all, are embryonic at present. The experience of the 1980s suggest that these huge sums will not be forthcoming. Official financing agencies, such as the World Bank, in recent years have supplied approximately US$7 billion per year.[6] It is unlikely that these official flows will be substantially increased, given the many other claims on these types of funds from other economic sectors (or from Eastern Europe and Russia, for that matter). Private

---

[4] See footnote 2.
[5] Almost 85% of these domestic capital requirements will have to be raised in just two countries: India and China: Moore, Edwin A. and Smith, George, *Capital Expenditures for Electric Power in Developing Countries in the 1990s*, World Bank Industry and Energy Department Energy Series Working Paper No 21, Washington, DC, 1990.
[6] Schramm, Gunter, *Electric power in developing countries: status, problems, prospects*, Annual Review of Energy 1990, Annual Reviews Inc., Palo Alto, CA, 1990.

foreign financing agencies that until the early 1980s had supplied the bulk of foreign exchange sector funding (usually via direct loans to the respective governments) had largely withdrawn from lending by the mid-1980s, given the mounting difficulties of may of the LDCs' governments in servicing their debts. These, by that time, included some US$60 billion of publicly guaranteed power loans.

Against this backdrop, some of the options to tackle the problem of lacking investment capital include: doing less (i.e., increasing operational and financial efficiency);[7] opting for less costly rehabilitation instead of construction of new facilities;[8] rearranging investment priorities; increasing revenues (via higher tariffs, improved collection methods, reduction of non-technical losses); and commercialization and/or private-sector participation. We will pick up on the last option in depth in Chapter 2.

1.2.2 Poor financial performance

Directly linked to the problem of raising investment capital, as well as to problems of inadequate performance, is the poor financial performance of the majority of publicly owned developing country power utilities. Average financial rates of return were less than 5% between 1987 and 1989, having fallen to as little as 2.8% in 1989.[9] Clearly, from a financial perspective, an industry whose rate of return is consistently below the market interest rates can hardly expect to be welcomed in domestic or world financial markets.[10]

Poor financial performance of the power industry does not only affect it ability to raise investment capital. The lack of adequate income has an even more deleterious effect

---

[7] Jhirad, David, *Implementing power sector solutions in developing countries*, Paper prepared for the Conference of the Stockholm Initiative on Energy, Environment and Sustainable Development (SEED), Stockholm, 13-14 November 1991.

[8] United Nations (UNCTAD) New York, and Exportradet, Swedish Trade Council, Stockholm, *United Nations Seminar on Energy Conservation in Developing Countries, Executive Summary, Conclusions, and Recommendations*, Stockholm, 3-9 September 1989.

[9] World Bank, Infrastructure and Energy Division, and OLADE, *The Evolution, Situation, and Prospects of the Electric Power Sector in the Latin American and Carribean Countries*, Report No 7, Vol 1, World Bank and OLADE, Washington, DC, 1991.

[10] *Ibid.*

on the day to day performance of the utility itself, on its inability to attract and hold competent managerial and technical staff. The two major factors responsible for the poor financial performance: inadequate tariffs and poor revenue collection are described next.

1.2.2.1 Inadequate tariffs

Average tariffs have drifted down from an already low US 5.21 cents/kWh in 1979 to US 3.79 cents/kWh in 1988, a reduction of some 32% in real terms.[11] There was no economic or financial justification for such declines; in most cases they came about because of high rates of domestic inflation and the unwillingness of governments to adjust tariffs accordingly. The weighted average tariffs of a sample of 63 developing countries, expressed in 1988 US dollars, were US 4.46 cents/kWh in 1988, compared with a weighted average for all OECD countries of US 8.07 cents/kWh, a difference of more than 80%. While there are few utility operations in the developing world that have inherently low cost structures (low cost hydro, short transmission lines, mainly large volume customers), in general, on technical and economic grounds (mostly imported equipment, less than optimal system sizes, low average consumption per connection), average tariffs should be significantly higher in developing countries than OECD countries in order to cover costs.[12]

1.2.2.2 Poor revenue collection

Poor meter reading, accounting and billing; inaccurate record keeping, lack of meters, and non-payment by governmental organizations that cannot be disconnected are some of the causes of poor revenue collection performance. Accounts receivable, expressed in months outstanding, are commonly used as a measure of good or poor revenue collection performance. Based on a sample of 51 countries taken from 1988 data, there were a number of well performing utilities with averages of less than 1.5 months outstanding while there were others that had averages of 15 months or more. The mean

---

11

12 *Ibid.*

average was 4.3 months. For the sake of comparison, the US average was slightly less than 1 month.[13]

1.2.3 Inappropriate investment policies

A number of utilities are plagued by continuing capacity shortages, but many others, in fact, have substantial excess generating capacity. In well run utilities, reserve capacity margins are usually kept at somewhere between 15% and 30% above peak load, depending on system characteristics. In the majority of developing countries, however, the capacity reserve margins are excessive—typically between 40% and 59%. The overall average for a sample of 70 developing countries was 43%. Relative to the 1989 total systems load of 331 GW and a target reserve margin of 30%, this means the excess capacity was 43 GW, representing an investment of about US$50 billion, using $1150/kW as the weighted average mix of capital costs for hydro, thermal, nuclear and geothermal.[14] The 43 GW capacity savings would meet two years of load growth at 6-7% per annum. Following this line of argument, improved maintenance to increase unit availability and reduce the capacity reserve margin to 30% could save both US$50 billion initially and roughly US$25 billion each year (starting in year 3) in terms of future generating investments.

While potential of huge savings exist in countries with excess generating capacity, there has been, however, a systematic neglect of subtransmission and distribution investments and maintenance, with the result that circuits are overloaded, voltage drops chronic and power supplies in general highly unreliable.

1.2.4 High system losses

Any power system will incur technical losses in transmission and distribution, but with the present technology, these losses generally range between 7% and 10%. In a sample of 94 utilities (1988), only 8 had system losses of 11% or less;[15] another 34, or slightly more than one-third, had losses ranging more between 11% and 16%, while some

---

[13] World Bank and *op cit*, footnote 9, OLADE
[14] *Ibid.*

21 showed losses in excess of 21%.[16] System losses above 15-16% are almost always the result of inaccurate and often fraudulent billing and collection systems, or of outright theft through meter tampering or illegal connections.[17]

1.2.5 Poor operating performance

Unreliable service and frequent outages, high voltage and frequency fluctuations, excessive generating capacity margins, short life expectancies of plant and equipment, high system losses, and excessive pollution loads on the environment are all various manifestations of poor operating performance. For electricity users, failure to receive uninterrupted electricity is by far the most costly consequence of the poor operating performance of utilities. As has been shown in a number of studies, the cost/kWh of electricity not supplied, when supply was expected to be forthcoming, can be, and usually is, exceedingly high, in the order of several times the long-run marginal costs of supply. In estimated cost/kWh, this translates to anywhere between $0.25/kWh and as much as $12/kWh in developing countries, depending on type of use, time of day, duration, frequency, and availability of substitutes.[18]

In the preceding section, we observed that developing countries had generally ample generation capacity reserves; so why this acute shortage? In most cases it is found that most of the generation capacity is unavailable because of breakdowns, lack of spares, and generally poor maintenance. This is apparent from the very low generation capacity factors achieved by the majority of developing country utilities. In a sample of 98 utilities (1988) only 10 achieved a capacity factor of 50% or more; some 59 of them achieved 40% or less, and 14 had a factor less than 25% or less.[19]

---

[15] System losses refer to combined technical and non-technical losses. They are calculated on the basis of net generation minus total sales, divided by net generation.

[16] Escay, Jose R., Summary 1988 Power Data Sheets for 100 Developing Countries, World Bank Industry and Energy Department Energy Series Working Paper No 40, Washington, DC, 1991.

[17] Schramm, Gunter, *Technical and non-technical power losses in developing countries*, Paper presented at ELEC 88, Paris, November, 1988.

[18] Schramm, Gunter, *Issues and problems in the power sectors of developing countries*, Energy Policy, July 1993.

[19] *Ibid.*

1.2.6 Manpower issues

Inappropriate skill mixes, overstaffing, but, at the same time, shortages of competent middle-level management and technical staff, low staff morale, inadequate compensation for skilled personnel with alternative employment opportunities, inability of management to make independent hiring and firing decisions, and lack of training facilities are some of the major issues that have been identified as root causes for poor institutional performance.[20]

Overstaffing is a serious problem in many developing countries. While the better performing utilities have ratios of utility customers to the number of employees between 150 and 400, the poorest ones show ratios of 50 or less. Most of the overstaffing occurs in the semi- and unskilled categories and is usually the result of heavy handed government attempts to use the publicly owned utilities as employment pools.[21]

1.2.7 Institutional and management issues

A prevalent phenomenon that is partly, if not wholly, responsible for the poor performance of public utilities throughout developing countries is government interference in many organizational and operational matters that should be left under utility control. Such intervention undermines the accountability of those responsible for day to day management functions. It also heavily influences procurement decisions, often opening them up for graft and corruption. Governmental, politically motivated interference mitigates against least cost choices for plant, equipment and fuel; it distorts the allocation of funds between rehabilitation and maintenance on the one hand, and investment in new plant and equipment on the other; it results in the inability to raise power tariffs to levels that would cover costs; and it restricts the utility's access to foreign exchange. Furthermore, it mandates low utility staff salaries, often tied to civil service pay levels rather than competitive market wages. It also promotes overstaffing, often through no firing rules based on inappropriate civil service models. These factors, in turn,

[20] Energy Development Division, Industry and Energy Department, Core Report of the Power Utility Efficiency Improvement Study, World Bank Industry and Energy Department Energy Series Working Paper No 46, Washington, DC, 1991.
[21] *Op Cit*, footnote 15, Escay.

have contributed heavily to inadequate utility management and organization, lack of accountability, the loss of experienced and capable staff due to non-competitive employment conditions, weak planning, inefficient operation and insufficient maintenance, high technical and non-technical losses, and weak financial monitoring, controls and collections.[22]

1.3 The Solution: Ownership and Incentives

At this point, we have equipped ourselves with sufficient information to answer the question we began this chapter with: Why restructure? This thesis—grounded on the evidence of institutional problems described in the preceding section—will argue that lack of incentives and accountability in developing country electric utilities is derived from inefficiencies of their prevailing ownership structures. We borrow some of the economic theories of firms discussed in the next section to strengthen this argument.

1.3.1 Economic Principles of Efficient Ownership

Going back to Adam Smith, when property rights over a productive asset are clearly defined, and the person who decides how to employ this asset bears full costs and enjoys full benefits of such employment, he puts the asset to its most productive use.[23] In the words of economists, the person has both control rights and cash flow rights over his assets.[24] Control rights include all rights to make decisions on how to use the asset such as to lease it, sell it, or to give it away. Cash flow rights are the rights to earn benefits and pay costs that result from a particular use of the asset. The above economic theory, pushed forward by proponents of privatization, provides a rationale for relying on private property as the basis for an efficient organization of economic activity in a society. Poorly defined property rights—characterized by lack of protection of property and of

[22] *Op Cit*, footnote 19, EPUES

[23] Boycko, Shleifer, and Vishny, *Privatizing Russia*, The MIT Press, Cambridge, 1995.

[24] The distinction between cash flow and control rights, as well as the foundations of the analysis that follows, are due to Sanford J. Grossman and Oliver D. Hart, *The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration*, Journal of Political Economy 94, 1986; and Oliver D. Hart and John Moore, *Property Rights and the Nature of the Firm*, Journal of Political Economy 98, 1990.

enforcement of contracts—by extension would cause inefficiency in the underlying ownership structure.

Applying this theory to public enterprises in socialist and mixed economies, we observe the clearest evidence of inefficiency in ownership structure: Politicians have substantial control rights and 'the state' which usually means the treasury has all the cash flow rights.[25] Moreover, control rights may actually be split between ministers overseeing the enterprise and the bureaucrat or manager running the enterprise. In some cases, the manager has some cash flow rights because he is on an incentive contract tied to the profits of the firm. In practice, such incentive contracts are extremely uncommon, and, even in a few cases where they have been tried, politicians overseeing the enterprises have quickly repealed them once managers actually tried to maximize profits.[26]

Meanwhile, politicians—empowered by control rights—seldom pursue objectives that maximize efficiency of the firm. Political intervention through overemployment, excess wages, costly investments in unproductive ventures, unenforceable contracts (i.e., bribes) to get around inefficiencies are the typical inefficiencies plaguing a public firm [See Section 1.2.7].

One path to efficient ownership is to hand over *both* control and cash flow rights over the firm to the manager. Control rights would have to be transferred to the manager through a legal reform.[27] This reform would ideally entitle a private entity the control rights over public assets and would give mandate to the court of law to enforce them. The principal form of this reallocation is called corporatization (or commercialization). Following corporatization, efficient ownership demands that cash flow rights be allocated from the Treasury. This transfer, known as privatization, can take a variety of forms, but usually involves either a sale or a subsidized hand-over of cash flow rights to the managers as well as other investors who share control rights with them.[28] Privatization brings the manager a legal, secure, and transferable cash flow claim. Armed with both

---

[25] *Op cit*, footnote 22, Boycko et al.
[26] Nellis, John, *Contract Plans and Public Enterprise Performance*, World Bank Staff Working Paper No 118, 1988.
[27] *Op cit*, footnote 22, Boycko et al.
[28] *Ibid.*

control and cash flow rights, the manager is in the best position to maximize the profits of his enterprise.

In practice, however, very few developing countries have reformed their electric utilities, or for that matter, any public infrastructure, to the extent described above. Many governments stop at corporatization and hesitate to go beyond. Lack of political will, weak institutional and regulatory arrangements, and macroeconomic instability are some of the frequently cited reasons for not going beyond the transfer of control rights.

Depending on the degree of private-sector participation, however, four basic options for institutional reform exist for governments, public sector agencies, and private groups to assume responsibility for different aspects of service provision [See also Figure 6g in Appendix]. These options are briefly discussed next.

1.3.2 Options for Institutional Reform

The following options represent different allocations of ownership, financing, and operation and maintenance responsibilities, and also of risk between government and the private sector.[29] Each option requires three broad actions: applying commercial principles to infrastructure operations, encouraging competition from appropriately regulated private sector providers, and increasing the involvement of users and other stakeholders in planning, providing, and monitoring infrastructure services.[30]

1.3.2.1 Option A: Public Ownership and Public Operation

In many power infrastructures of developing countries, the most common vehicle for ownership and operation is a public entity—a parastatal, public enterprise, public authority, or governmental department—owned and controlled by the central, regional, or local government.[31] The delivery of services are efficiently carried out when these public entities run on commercial lines, freed from government budget and civil service constraints and subject to normal commercial codes and regulations. Competition from private firms also pressures public providers to improve their performance.

[29] The World Bank, *World Development Report 1994: Infrastructure for Development*, 1994.
[30] *Ibid.*

1.3.2.2 Option B: Public Ownership and Private Operation

Through concessions or leases, the public sector can delegate the operation of infrastructure facilities (along with the commercial risk) and the responsibility for new investment to the private sector.[32] For example, a part of the national power transmission system may be concessioned to a private monopoly for a period of 75 years. Leases and concessions permit private sector management and financing without the dismantling of existing organizations or the immediate crafting of an entirely new regulatory framework.

1.3.2.3 Option C: Private Ownership and Private Operation

Private (including cooperative) ownership and operation are most attractive to the private sector when there is high potential for securing revenues from user charges and when commercial and political risk are low. This option is likely to apply most readily in activities that lend themselves to competition, such as power generation, and more recently, transmission and distribution. We will discuss in detail different structural, competitive, and regulatory frameworks of based on this option in next chapter.

1.3.2.4 Community and User Provision

For municipal and local services, user provision or community self-help arrangements that provide smaller-scale infrastructure—such as isolated microhydro plants—can provide effective and affordable service in many areas, when those contribute to the costs are the primary beneficiaries.[33] Community self-help schemes must be selected, designed, and implemented locally—not imposed from outside. They may also offer the only feasible approach in informal periurban settlements and rural areas until the more informal supply systems expand their networks sufficiently.

1.4 **Summary**

We addressed three issues related to the idea of power utility restructuring: First, we identified financial, managerial, and institutional problems rooted in most state-owned electric utilities. Second, we borrowed economic principles of property rights and

---

[31] *Ibid.*
[32] *Ibid.*
[33] *Ibid.*

ownership structure to explain and to possibly rectify these problems. And third, guided by these economic tenets, we cited four broad institutional alternatives. Our discussion from here onwards will assume Option C as our choice for institutional reforms. The rationale for this choice is that a substantial number of developing countries including Chile, Argentina, and Malaysia have successfully applied the above economic principles to reform their electric utilities. The experiences from these reforms we hope would directly feed into reform strategies of other aspiring governments.

2. MODELS FOR STRUCTURE, COMPETITION, REGULATION, AND THEIR INTERACTIONS

The problems of dwindling investment capital, financial mismanagement; inappropriate investment policies; operational, institutional, and environmental deficiencies discussed above have forced many developing nations scrambling to search for solutions. Privatization—the transfer of ownership of state-owned assets to the private sector—has arguably been the most sought-after recipe by willing policy makers in developing countries since it swept Chile, New Zealand, and the United Kingdom in the 1980s. At least 300 infrastructure privatizations have been undertaken since 1989—mostly in Latin America, East Asia, and selected OECD economies.[1] Whether this privatization wave will lead to lasting welfare gains or is just part of a historical cycle of privatization and nationalization is not yet clear. The answer will largely depend on whether governments can balance regulation with competition best suited to maximize net welfare gains. An overarching issue that must be identified up front, however, is that of political willingness: In the name of economic nationalism, the developing country government has strong interests in controlling the destiny of an industry so central to the economic infrastructure. This concern lay behind many electricity nationalizations that occurred this century. This chapter will attempt to gather evidence to illustrate the possibility of having considerable level of private ownership without losing government oversight of the rules of the game in the electric utility.

[1] Klein, Michael and Roger, Neil, *Back to the Future: The Potential in Infrastructure Privatization*, Private Sector Notes, Public Policy for the Private Sector, Financial Sector Development, The World Bank, November, 1994.

2.1 **Issues**

A policy maker considering privatization of the country's government-owned and operated electricity supply industry needs to address five fundamental issues:[2]

- Should the electric utility, or segments of it, be privatized at all?
- What should be the structure of the privatized industry?
- Where and how should there be competition?
- How should the privatized electricity sector be regulated?
- What method or process of privatization should be used?

The first question, should there be privatization, is tied to the distinctive economic needs and political realities of the country concerned. As already discussed, several factors such as huge investment capital, poor financial performance through misplaced pricing policies, operational, managerial, institutional, and environmental issues are generally the chief motivations for inviting private participation at varying degrees. This issue, however, cannot be addressed in meaningful detail for any country without looking into the specifics of that country. Moreover, passing a judgment on whether a particular country's electricity provision, or part of it, should be privatized lies well beyond the purview of this thesis. We will, however, explore specific policy reasons for privatization in Chapter 3.

Similarly, the last question, how should privatization be implemented, demands in-depth analysis of constitutional, institutional, and regulatory procedures to be satisfactorily tackled. Again, we leave this issue here with the hope that it will be more competently reviewed somewhere else. We will deal with the remaining three questions by highlighting the characteristics of four structural models of electricity provision and then identify the roles of competition and regulation in each of these models.

Since most of the findings in this chapter are based on privatization experiences of UK, USA, and Europe it would be appropriate to define some electric utility terms that are understood differently in these countries and also to briefly review the physical characteristics of the electric power system.

---

[2] Tenenbaum, Bernard; Lock, Reinier and Barker, Jim, *Electricity privatization: Structural, competitive and regulatory options*, Energy Policy, December 1992.

2.1.1 Terminology

In the USA, distribution refers to the sale of two bundled services to retail customers by a vertically or non-vertically integrated company.[3] The services are electricity supply and electricity transportation over high and low voltage lines. In the UK, however, distribution has a narrower meaning. It refers to unbundled transmission of electricity over distribution lines (i.e., lines with voltage of 132 kV or lower). The companies that perform this function in England and Wales are called regional electricity companies (RECs). The RECs also offer an unbundled supply service. This refers to the acquisition and sale of electricity on an unbundled basis (i.e., without the transportation or wires charge) to retail or end-user customers. In Britain, RECs do not have an exclusive franchise on the supply business within their territories. Other RECs, brokers or generators can compete to sell electricity to a growing number of customers in the service area of any REC. Thus, in Britain, when someone refers to a supplier, they mean any entity that sells to retail customers. The same term has a different meaning in the USA. A supplier in the USA usually means an integrated or non-integrated company that sells electricity in the wholesale market. Outside the USA, wholesale competition is usually described as competition in generation. Retail competition, in the USA, is defined as competition to sell electricity to industrial, commercial and residential end-use customers. Outside USA, this is known as franchise or supply competition. In the USA wheeling, or the unbundled transportation of electricity over high and low voltage lines is typically categorized into 2 groups: retail and wholesale. Outside the USA, wholesale wheeling is usually described as wheeling or transmission for generators.

2.1.2 Technology

That the only function of the high voltage grid is to transmit electricity is too simplistic an assumption. The interconnected grid is an important element in maintaining the overall reliability of the whole electric supply system.[4] Within an interconnected grid, the actions of a single generator or the failure of a single transmission line can cause the

---

[3] *Ibid.*

[4] Fox-Penner, Peter, *Electric Power Transmission and Wheeling, Edison Electric Institute*, Washington, DC 1990.

electrical collapse of the entire grid. To prevent this from happening, one or more entities must be responsible for maintaining the stability of the interconnected system. For the purpose of this discussion, we will assume that it is a single entity and refer to it as the system dispatching agency. This agency has three essential responsibilities: First, it needs to schedule generation plants minute by minute to ensure that, at any time, demand is balanced by supply since electricity cannot be stored in bulk. Second, it needs to have a ready contingency plan that can be instantly implemented in case of a supply failure. Finally, it must develop and coordinate generation and transmission maintenance schedules. In most existing electricity systems, the owner of the transmission grid is also the system dispatch agency. Thus, a single entity performs all three functions—transmission, reliability and dispatch. This is the prevailing mode in developing countries and most of the industrial countries. However, there are alternative approaches. For example, utilities in the mid-Atlantic and north-east regions of the USA have ceded central dispatch and, to some degree, reliability to a higher level cooperative organization known as a power pool.[5]

The point to be driven home here is that regardless of which industry structure is selected, the grid cannot operate successfully unless the structural model accommodates the above three functions.

2.2 Structure

In simplified terms, there are four basic models of industry structure, each with several variations. The models differ by how much restructuring is required. In the subsequent chapter, we use six models of industry structure examine the impact of various degrees of vertical deintegration on the performance of energy service provision.

While it is perfectly reasonable to discuss restructuring in the context of already privatized entities, we will look into restructuring as a gateway to privatization.

[5] The term power pool is used in the USA to describe a broad spectrum of cooperative arrangements among independently owned utilities. *Op cit*, footnote 2, Tenenbaum et al.

Model 1

This model is the traditional industry structure prevailing in the USA.[6] It consists of one or more vertically integrated, privately owned electricity companies, usually serving well defined regional service territories. Each company owns its own generation, transmission and distribution facilities. If this model were chosen in developing countries, a government monopoly will be replaced with one or more private monopolies. Stated differently, there is privatization without competition. Of the four models, this is the easiest to implement because it keeps the existing structure intact. On the contrary, the long-run rewards from this arrangement may be very limited.

Model 2

This model continues the traditional structure with competitive procurement of generation.[7] Each company owns all of the distribution and transmission facilities in its service territory, but only some or none, of the generation plants needed to serve its retail or end-use customers. Such a structure could develop if all state owned generating plants that existed at the time of privatization were transferred to new private companies. Then after this initial transfer is made, some or all new plants are built and operated by separate independent generating companies controlled by other domestic and/or foreign investors. The companies that owned the transmission and distribution facilities can be given the option of meeting incremental demand by self-construction or long-term power purchases from independent suppliers.[8] This model creates a mixed regulatory system: deregulation of new generation with continued regulation (or government ownership) of transmission and distribution.

---

[6] *Ibid.*

[7] *Ibid.*

[8] In India and Korea, it appears that the government will retain ownership of existing plants while seeking private independent investors to build, own and operate (BOO) new generating plants. This is a form of incremental or partial privatization. See *Delegation from India coming to US seeking developers for 22,558 MW*, Electric Utility Week, May 17, 1992 and *South Korea to invite foreign firms to bid on two 500 MW coal plants*, Electric Utility Week, March 16, 1992.

Model 3

This model expands on the second model by introducing common or contract carriage whereby each private or government enterprise that owns high voltage transmission lines is now required to provide firm and non-firm transmission service to other wholesale electricity buyers and sellers.[9] Model 3 seems to be preferred by government authorities who want to go beyond competitive procurement of new generation but who are constrained, for political or other reasons, to working within an existing industry structure that remains unchanged. What changes is that those who own transmission have a new obligation: they must provide transmission service to possible competitors at reasonable prices and on reasonable terms. In effect, transmission access is grafted on to an existing vertical industry structure.

Model 4

The last model is the new British (England and Wales) and, more recently, the Argentinean model.[10] It requires complete vertical separation of generation, transmission and distribution. The entire high voltage transmission grid is owned by a new separate company that has a common carrier obligation to all buyers and sellers of electricity and which also provides the system dispatch system, that is, determining which generating units should produce electricity at any given moment. The distribution companies provide unbundled transmission at distribution voltages and sell electricity to wholesale and retail customers within and outside their traditional service areas. Like the transmission company, the distribution companies have common carrier obligation on their wires services.

By referring to this model as the British model does not imply that the model will work only if implemented exactly as designed by the British in their 1990 privatization.[11]

---

[9] A common carrier is usually defined to be an entity that is required to transmit electricity for buyers and sellers on a non-discriminatory basis and, if necessary, to construct additional capacity if the existing capacity is inadequate to meet all requests. See Bonbright, John; Daneilson, Albert and Kamerschen, David, *Principles of Public Utility Rates*, Public Utilities Report, Arlington, VA, 1988.

[10] The British model refers to the structure adopted in England and Wales, *Op Cit*, footnote 2, Tenebaum et al.

[11] *Ibid.*

The basic vertically deintegrated structure that now exists in England and Wales could be adopted elsewhere without three features that were incorporated in the British privatization: retail competition, up to 15% equity stakes in generating stations by distributing companies, and a spot market mechanism for clearing up energy and capacity transactions.[12]

2.3 **Competition**

Two issues that arise when competition is contemplated are: How deep should competition cut and, once this is decided, how should it be introduced?[13]

It is generally agreed that at least the generation function is potentially competitive and that the transmission and distribution functions are, in most circumstances, natural monopolies.[14] In most countries the distribution company is granted a franchise service territory with a more or less exclusive monopoly right and accompanying obligation to provide end-use customers the service they need.[15] Generally, the exclusive right to serve is maintained by the utilities' monopoly control over transmission facilities. The key to significant competition on most systems comes down to who has access, or the right to use, the utilities' transmission system on reasonable terms and conditions. Most privatizing governments will have two fundamental options.[16] These are described next.

2.3.1 Wholesale/non-franchise access

The first option would be to limit competition to the non-franchise level, typically the wholesale level, by allowing only generators and distribution utilities access to the transmission grid in order to give the latter increased options as to power supply.[17] As the high voltage transmission grid has grown in the USA, some level of competition in these markets has developed even without major government intervention to guarantee access

---

[12] *Ibid.*
[13] *Ibid.*
[14] Schmalensee, Richard, *The Control of Monopolies*, DC, Heath, Lexington, VA, 1979.
[15] *Op Cit*, footnote 2, Tenenbaum et al.
[16] *Ibid.*
[17] *Ibid.*

for these entities to transmission service. This competition has been facilitated by a significant level of voluntary access or wheeling granted by utilities, especially as to each other's surplus capacity, and to the development of independent power sector under federal regulatory guarantees that guarantee some market, albeit often localized, for their power. The issue of mandatory wholesale access has proved highly controversial in both the European Community and the United States.[18] Those supporting the mandatory wholesale access argue that it is the fundamental prerequisite to a fully competitive generation market. Those who oppose it, usually transmission owning utilities, have argued that that the only way to run an electric power system is an integrated monopoly. They contend that open access and competition threaten both the technical reliability of utility systems and their long-term economic efficiency and assurance of supply.

2.3.2 Retail or franchise access to end-use customers

The yet more controversial and difficult issue is whether the competing generators should also have transmission access to end-use (retail) customers.[19] From the supplier's perspective, this implies providing customers transmission access to other suppliers and hence bypass the previous exclusive supply monopoly. This possibility raises serious system reliability and long-term efficiency concerns. Moreover, that a right of end-use customers to leave their systems at will could lead to serious stranded investment problems that may, in turn, raise prices for remaining customers and may even threaten the financial viability of distribution monopoly.[20] The stranded investment concern is particularly acute for vertically integrated systems that have built capital intensive, long gestation facilities to meet the expected load or demand of franchise customers on a long-term basis. In the US, many distribution companies heavily depend on long-term power contracts with independent power producers and, thus, fear that retail access will undermine the current franchise system.

These valid concerns are, however, not intractable. The stranded investment dilemma can be overcome by imposing notice of direct compensation requirements on

---

[18] *Ibid.*

[19] *Ibid.*

end-use (or wholesale distribution) customers leaving the franchise system, and on those, having left, wishing to return to the system for assured service.[21] These requirements would be related to the utility planning horizons for additional capacity investments and would be designed to protect the utility from stranded investment losses and to protect remaining customers from returning customers' threatening adequacy of service.[22]

Free-rider problem is another potential concern that needs to be addressed when retail access is being considered. For example, non-franchise customers wheeling power from a franchise grid would be receiving reliability benefits at the expense of franchise customers if they are not required to procure sufficient generating capacity.[23]

At least three models have emerged for accommodating end-use or retail access: The first model would permit access for end-users of a certain minimum size alone.[24] The second model would permit access for new customers or for incremental loads only, that is, new demand, but would not permit customers access to switch suppliers for existing loads.[25] The third model would permit customers to select whether they preferred to be served on a monopoly franchise, assured supply basis or to shop on the competitive bulk power markets for their own supply. Such a system could permit customers to move from one to the other regime with reasonable notice.[26]

2.3.3 A Phased Strategy

Against this backdrop of restructuring challenges, a gradualist approach worth pursuing would be for privatizing governments to limit competition, at least in the early years of privatization, to the generation level (i.e., non-franchise access) and not enter the

---

[20] *Ibid.*

[21] In the USA, this is sometimes called the prodigal son problem, *Ibid.*

[22] Tenebaum et al. proposed these safeguards to the Commission of the European Communities. The authors asserted that appropriate notice provisions should preserve the franchise distribution monopoly for those customers which preferred service; and that end-use competition and the franchise distribution monopoly could exist.

[23] This is an example of a network externality, *Ibid.*

[24] *Ibid.*

[25] In the USA, a form of access for new end-use customers is allowed in Georgia. See Georgia Territorial Electric Service Act. Ga. L. 1973.

[26] *Op Cit*, footnote 2, Tenebaum et al.

arena of end-use level competition.[27] That should make management of the economic and technical challenges and risks, and of political opposition to the privatization, immeasurably easier. We, therefore, examine two principal options for competitive generation that exist in the UK and the New England Power Pool (NEPOOL) in the United States.

2.3.4 Mechanism for Competition in Generation

In three of the four industry structure models, the restructuring is designed to introduce competition in generation. If one of these three models is selected, it is still necessary to decide how the competition will occur. The two principal options are the competitive mechanisms that exist in the UK and the New England Power Pool (NEPOOL) in the United States.[28] The question then is which competitive mechanism will lead to the greatest operating and investment efficiencies.

In the UK, the competitive mechanism is a half-hourly spot market for capacity and energy backed up by a variety of hedging contracts.[29] The National Grid Company (NGC) dispatches generating units on the basis of price offers received for individual generating units. The grid company's dispatchers do not know the variable operating costs of individual generating units. Instead, they attempt to create an optimal pattern of dispatch in every half-hour from the quantities of power that the separate generating companies are willing to offer at specified prices. The price received by generators known as the pool input price (PIP) has two principal components: a spot energy price and a capacity element. The spot energy price is the price of the highest bid accepted by NGC in each half-hour. All generators that are scheduled to run receive this single price. The capacity component compensates generators for making their unit available even if the unit is not scheduled to run.

---

[27] *Ibid.*

[28] *Ibid.*

[29] Strictly speaking, the UK market is a forward market because sellers are committing to sell their electricity at specified prices for different half-hour periods on the following day. In contrast, a true spot market is characterized by immediate delivery of the product. See Hunt, Sally and Shuttleworth, Graham, *Forward, Option and Spot Markets in the UK Power Pool, National Economic Research Associates, London*, 1991.

A different competitive mechanism is used in the New England region of the USA.[30] Within New England, more than 90 individual utilities are members of a cooperative organization known as the New England Power Pool. Each NEPOOL member is obligated to install or to purchase generating capacity which is sufficient to meet the peak demand of its retail and firm contractual customers plus additional reserves to protect against emergencies. Once this capacity or firm energy obligation is met, the member provides the pool dispatch center with information that can be used to calculate variable operating cost at different loading levels for each of its generating units. With this information, the pool dispatches all units to minimize the hour to hour cost of producing electricity for the entire region. The pool also establishes maintenance schedules for all generating units to minimize the region's total production cost.

2.3.5 Assessing performance

The relative performance of the NEPOOL and British approaches to competition must be assessed in several dimensions:[31]

- Is there adequate investment in new capacity?
- Is it the right kind of capacity?
- Is generation dispatched on a least cost basis throughout the year?

While no definite answers exist since both the market mechanisms are in transition, preliminary observations, however, can be made at this point. Neither the NEPOOL nor the British system seem to have any problems in attracting capital for new generating capacity. The technology of choice for generation capacity expansion in both these countries appear to be combined cycle gas turbines (CCGTs). These turbines are economic at smaller sizes, can be built in a shorter time than coal fired units, and provide environmental advantages relative to coal. Whether this technology turns out to be the correct economic choice for both systems can only be known with the passage of time.[32]

What drives investment decisions in the two mechanisms? In the UK, it was originally anticipated that the capacity component of the spot market would influence

---

[30] ECC Inc. Proceedings of Power Pooling Conference, Fairfax, VA, 1988.

[31] *Op Cit*, footnote 2, Tenebaum et al.

such decisions. All new generators, however, obtain most of their revenues from hedging contracts—independent of the pool—and not the loss of load probability (LOLP) component of the pool input price.[33] It has been estimated that about 95% of the electricity generation is sold at contract rather than spot prices.[34] If the capacity component were to be removed from the spot market pricing formula, the purpose of the pool would be limited to static efficiency—achieving a daily merit order dispatch. The investment decisions that determine long-term efficiency would be driven by the hedging contracts. This change would make the British and NEPOOL competitive mechanisms similar, even though the industry structures remain distinct.[35]

The differences between the two competitive mechanisms are more significant when we deal with short-term cost minimization.[36] Both systems strive for a least cost pattern of dispatch. The NEPOOL system dispatches on marginal cost while the British dispatches on bid prices. While it seems reasonably certain that NEPOOL is achieving a least cost pattern of dispatch the evidence from the British system is not so clear. The prices in the British spot market may diverge from marginal cost because most generators only derive a small share of their total revenue from the pool. This may create incentives for gaming. An actual study—comparing this method of dispatch with that which would have occurred if the merit order dispatch had been based on marginal costs—is in want.

2.4 **Regulatory Options**

Each of the industry structure models we have described above contains a mix of competitive and monopoly characteristics. Governments—developing and industrialized alike—have traditionally checked monopoly rents sought by public and private enterprises. Ideally, regulation should put pressure on the monopolist so that it performs

---

[32] *Ibid.*
[33] Dr. Dieter Helm's testimony in House of Commons, Energy Committee, *Consequences of Electricity Privatization*, Vol I, HMSO, London, Feb. 1992.
[34] *Ibid.*
[35] *Op Cit*, footnote 2, Tenebaum et al.
[36] *Ibid.*

in price, profit, output and efficiency as if it were in a competitive environment.[37] The two principal regulatory approaches are cost-of-service or rate of return regulation and incentive regulation.[38]

2.4.1 Cost-of-service-regulation

The cost-of-service regulation model has dominated utility ratemaking in the US for most of this century.[39] In this method, the regulatory agency sets the company's overall revenue requirements equal to its total costs. Total costs are comprised of operating expenses, capital costs and an allowed rate of return on some measure of invested capital.[40] Costs may be keyed to historic costs or estimates of future costs. Once an overall cost or revenue level is set, it is then allocated among different customer groups. Cost-of-service regulation closely resembles civil court cases that take place in the United States.[41] Typically, a contested rate will include witnesses for the company and opposing parties, filed testimonies, cross-examination by lawyers, appeals, etc. Cost-of-service regulation has two main drawbacks:[42] First, this type of regulation is capable of ensuring that prices are determined by historical costs, but it is less capable of ensuring that costs are at an efficient level. Second, cost-of-service regulation does not create good incentives for innovation and service flexibility, as is necessary to deliver the greatest possible satisfaction to customers. Some limited incentives, however, do exist.[43] For example, rates are not automatically adjusted to reflect cost changes. There can be a regulatory lag of months or years before a utility is allowed or ordered to change its rates. During this lag period, utility managers have an incentive to be efficient to minimize

---

[37] Breyer, Stephen, *Regulation and its Reform*, Harvard University Press, Cambridge, MA, 1982.

[38] Yardstick competition and franchise bidding are two other control techniques that are often discussed but not widely used: *op cit*, footnote 14, Schmalensee.

[39] Jaffe, Adam B., Kalt, Joseph P., *An Economic Analysis of Electricity Industry Restructuring in New England*, The Economics Resource Group, Inc., Cambridge, MA, April, 1995.

[40] *Op cit*, footnote 2, Tenebaum et al.

[41] *Ibid.*

[42] *Op cit*, footnote 38, Adam et al.

[43] *Op cit*, footnote 2, Tenebaum et al.

losses if costs are rising or to maximize profits when costs are falling. Disincentives to build new plants under the cost of service regulation are equally possible. Second, there is no guarantee that a utility will be allowed to recover all of its cost. There is always a risk that a regulatory commission will find a particular operating or capital expense to be inappropriate and not allow the utility to recover the cost in its rates.[44]

These two features of cost-of-service regulation—regulatory lag and regulatory disallowances—provide, at best, weak and non-systematic efficiency incentives. Consequently, most observers would concur that the current US regulatory system was not designed to encourage utilities to control costs.[45]

2.4.2 Incentive Regulation

The USA has experimented with this type of regulation as a supplement to, rather than as a replacement for, cost of service regulation. In these cases, the incentive mechanisms are keyed to individual cost components or physical targets such as the availability levels of one or more generating plants. A recent empirical assessment suggests that these partial incentive mechanisms have not been very effective.[46]

The British system adopted a more far-reaching form of incentive regulation—the price cap regulation—with the RPI-X formula. The formula allows a company to raise its rates on regulated services from a base level by the change in the retail price index (an index not tied to the company's own costs) minus an X-factor targeted to the expected net effect of productivity increases, demand growth and the capital expenditures.[47] Within the British electricity industry, the RPI-X formula is being applied to the National Grid Company (NGC) and the transportation, captive and overall power sales of the

---

[44] A discussion of new nuclear power plants built in the US during the 80s can be found in Roger Naill and William C. Dudley in *IPP leveraged financing, unfair advantage?*, Public Utilities Fortnightly, Jan. 15, 1992.

[45] Joskow, Paul and Schmalensee, Richard, *Incentive regulation for electric utilities*, Yale Journal of Regulation, Vol 4, No 1, 1986.

[46] Berg, Sanford V. and Jeong, Jinook, *An evaluation of incentive regulation for electric utilities*, Journal of Regulatory of Economics, Vol 3, 1991.

[47] Littlechild, S. and Beesley, M., *The regulation of privatized monopolies in the United Kingdom*, Rand Journal of Economics, Vol 20, No 3.

distribution companies. In theory, the British system regulates price while the American system regulates profits.[48] In fact, the British program provides for something akin to a cost-of-service review every five years. The price produced by this review becomes the new base level to which the RPI-X applied. It is, therefore, probably more accurate to think of the UK approach as a rate of return regulation with an institutionalized five-year regulatory lag between cost of service reviews.

Most economists agree that the UK price-cap formula should produce better incentives for a regulated company to operate efficiently for the following reason: The company gets to keep five years of profits if it is efficient, while it loses money if it is not.[49] Potential shortcomings of this approach, however, do exist. First, will the British regulator be able to resist the temptation to make downward price adjustments if companies start earning higher than expected profits?[50] Second, will the regulated companies try to increase profits by reducing quality of service?[51] And third, will the formula provide sufficient incentives to encourage capital investments?

2.4.3 Conduct regulation

Cost of service and price cap regulation are examples of performance regulation. Performance regulation tries to influence the actions and decisions of the regulated company through specified targets rather than through direct control of the company's behavior.[52] Conduct regulation attempts at precisely the latter type of control. Conduct regulation, in essence, represents a failure of regulation.[53] A regulator has to resort to regulating conduct when a company needs to be forced to do what it does not want to do.

---

[48] *Op cit*, footnote 2, Tenebaum et al.

[49] *Ibid.*

[50] When 1991-92 profit figures were issued for the RECs, Professor Littlechild was quoted as saying that the companies 'have certainly made large profits' and that he could 'well understand' customers' concerns about this: *Power in Europe*, June 18, 1992.

[51] A major difference between cost of service and price cap regulation is that under cost of service regulation the regulator 'must police costs, but not quality'. Under price cap regulation, the regulator must police quality, but not cost. See Fox-Penner, Peter, *Quality maintenance and price-cap regulation*, Charles River Associates, Boston, MA, mimeo, June, 1992.

[52] *Op cit*, footnote 2, Tenebaum et al.

Conduct regulation is the backstop when the underlying industry structure or pricing regime fail to give the regulated company economic incentives to perform as the regulator thinks it should. In the US, conduct regulation has taken two principal forms. The first type—described as integrated resource planning (IRP)—allows the regulatory agency to be involved in the company's resource planning and selection process; parallel consideration of demand-side and supply-side options; explicit consideration of environmental costs; and greater public participation in the development of resource plans.[54] The second type—spurred by the introduction of competition—includes reviews of competitive procurements for new generating capacity based on given regulatory guidelines.

The UK has also exhibited signs of growing conduct regulation in its power industry. For example, in December 1991, Professor Littlechild, the chief regulator of the electricity industry in England and Wales, cautioned the two major generating companies against manipulation of the spot market price.[55]

The reality of conduct regulation, however, is that it may succeed in stopping one action to find that the regulated company is able to accomplish the same outcome using a variant of the prohibited behavior that had not been anticipated by the regulator. An electric industry thus has not achieved self-sustaining competition if the regulator finds himself chasing after conduct. It, therefore, appears that the better long-range solution is to get the structure and pricing right to minimize the need for conduct regulation.

2.5 **The Interaction among Structure, Competition, and Regulation**

So far, we have examined models for industry structure, competition, and regulation all in isolation. Reality, however, demands an inquiry into the feasibility of different possible combinations of all of the three elements. We go back to the industry structure models described in Section 2.2 and incorporate the other two factors.

---

[53] *Ibid.*

[54] Baraket, Howard and Chamberlin, *Moving toward integrated resource planning: Understanding the theory and practice if least-cost and demand-side management*, Electric Power Research Institute (EPRI), EM-5065, February, 1987.

[55] *Op cit*, footnote 2, Tenebaum et al.

2.5.1 Industry Model 1

This model is one of the most difficult ones to restructure to allow for competition. As explained in Section 2.2, the vertically integrated structure is already privatized here. If the government mandates further restructuring the private property-rights holder will expect reasonable compensation.[56] Without this compensation, the government may find it difficult take privatization beyond what had been envisioned as a temporary industry structure.

Cost-of-service regulation is the usual mode for regulating the non-competitive industry structure.[57] This structure-competition-regulation combination allows for very few incentives for the enterprise to be efficient.[58] Given the industry structure, one possible remedy would be to introduce yardstick competition among regional monopolies—wherever feasible—under an incentive-based regulation regime.[59]

2.5.2 Industry Model 2

This structure allows for incremental competition in generation and it also appears to be the preferred approach for developing country governments that wish to experiment with privatization in a limited way. Typically, the government will maintain its monopoly over the existing integrated system while offering domestic and foreign investors the opportunity to build, own and operate new generating plants.[60]

The US-based PURPA model has this industry structure. A major concern often put forward is that the transaction costs—the costs of negotiating and enforcing

---

[56] *Ibid.*

[57] *Ibid.*

[58] One study found that the cost/kWh of nuclear plants started in the same year by different US utilities with this structure sometimes varied by a factor of six. See Energy Information Administration, *An analysis of nuclear power plant construction costs,* Washington, DC, 1986.

[59] In yardstick competition, a criteria is chosen for comparison. This could be either the performance of others in the same industry or an external target or standard. Allowed revenues are then correlated to how well the firm performs in comparison to the selected criteria. See Cardell, Judith, *Utility regulation*, draft, Cambridge, MA 02139.

[60] *Op cit*, footnote 2, Tenebaum et al.

contracts—involved in assuring IPPs to perform well is so great that the benefits of vertical deintegration are nullified.[61] Proponents of this argument are, therefore, for single ownership of generation, transmission, and distribution. While economic theory gives no definitive answer nor has there been any empirical study that directly addresses this question for the electricity industry, three issues are worth considering. First, it is misleading to compare a vertically integrated structure with a vertically deintegrated structure without factoring in regulation.[62] A realistic assessment requires comparing a vertically integrated structure that is regulated and protected from competition with a vertically deintegrated structure in which the generation function is competitive and loosely regulated. Savings in transaction costs that result from integrating generation, transmission, and distribution in a single company must be reduced by the inefficiencies likely to be induced by regulation and the absence of competition.

Second, the relevant comparison is not complete vertical integration versus complete vertical deintegration either.[63] The experience to date shows that most countries that move to a vertically deintegrated structures generally choose to retain some part of the generating capacity under the ownership of the company that has the transmission and distribution functions. This mixed structure may provide some insurance to protect against opportunistic behavior by IPPs. It may also pressure the state-owned company to perform, at least, as well as the privately-owned company.

Third, negotiating a contract to purchase the output of an independent power producer is a complicated exercise that involves anticipating many contingencies.[64] These contingencies would not have occurred had there been a single vertically integrated company. Since state-owned enterprises probably have little experience with long-term purchase contracts, lending agencies such as the World Bank should encourage

[61] This concept originated in a classic article by Ronald Coase, *The nature of the firm*, Economica, Vol 4, 1937.
[62] *Op Cit*, footnote 2, Tenebaum et al.
[63] *Ibid.*
[64] *Ibid.*

borrowing countries to use independent buying agents with proven track records in successfully procuring new generating capacity.[65]

2.5.3 Industry Model 3

The third type of industry structure combines a core group of integrated monopolies in transmission and generation with competitive procurement of new generation and mandated common or contract carriage for, at least, all buyers and sellers in the wholesale market. [66] With common or contract carriage, buyers can now choose from among short- and long-term power suppliers in a larger geographic area.

Model 3 seems to be of most interest to large countries or regional groupings of several countries.[67] While short-term transactions between neighboring companies or countries are currently taking place wherever physical interconnections exist, guaranteed transmission access across a company's network would be a prerequisite to any long-term long-distant sales. International and intra-national sales do differ however, at least, in one respect: subsidies.[68] In a multicountry region, each country is likely to provide a different level of subsidy to its electricity industry. A supplier with less subsidy will naturally oppose competition with that receiving more subsidy. In Europe, this is known as the harmonization problem.

Model 3 may be adopted in the USA and Europe over the next several years with one significant difference. The proposed European version would provide access to large industrial customers to purchase from non-contiguous electricity suppliers. In the US legislation, retail access is forbidden.[69]

---

[65] Three US utilities that have developed sophisticated and successful procurement systems are Virginia Power, Florida Power and Light and the New England Electric System, *op cit*, footnote 2, Tenebaum et al.

[66] *Ibid.*

[67] *Ibid.*

[68] *Ibid.*

[69] Another possible difference relates to the extent of the transmission obligation. The European proposal requires third-party access to the extent there is capacity available while US FERC regulation requires the transmission owner to construct new capacity if unable to provide service from existing facilities. *Op cit*, footnote 2, Tenebaum et al.

We now go back to the earlier premise that Model 3 survives on common contract or carriage and examine its regulatory ramifications.

One practical difficulty with this structural model is that getting transmission owners to provide transmission service to each other when they may have an economic incentive not to do so. This implies that the regulator will need to force compliance.[70] This requires expanding the regulator's job from regulating profits to regulating conduct which, in turn, may demand thorough technical competence from the regulator to make a correct assessment. If this is expecting too much from the regulator then there has to some way of checking the transmission owner's non-competitive behavior.

Some industry groups in the US have responded to this dilemma by suggesting a variant of model 3 that requires a much smaller role for the regulator. This variant—usually referred to as regional or voluntary transmission agreement—combines continued separate ownership of high voltage transmission facilities with explicit contractual commitments to provide user rights to others.[71] It attempts to achieve transmission access through a single multiparty agreement rather than a multitude of individual transmission tariffs. The agreement is self-policing and the regulator's role is largely that of an arbiter. Limited version of regional transmission agreements exist in the US in Georgia and Indiana.[72]

An alternative to such regional transmission agreements is a competitive joint venture.[73] All transmission facilities in a regional grid would be owned by a separate company and each owner-user would own shares in the company. Each owner would get the right to use an amount of transmission capacity proportional to its ownership

---

[70] This assumes that the regulator has the incentive to pursue compliance. This, according to the authors, is not a plausible assumption if the regulator represents a constituency that would be hurt by compliance, *op cit*, footnote 2, Tenebaum et al.
[71] National Rural Electric Cooperative Association, *Special report: meeting of transmission access groups*, Power Supply Report, Washington, DC, April 1992.
[72] Integrated Transmission System Agreement between Georgia Power, Oglethorpe Power Corporation, the Municipal Electric Authority of Georgia and the City of Dalton, August 27, 1976 and Transmission and Local Facilities Ownership, Operation and Maintenance Agreement Between Public Service Company of Indiana Inc and Wabash Valley Power Association Inc and Indiana Municipal Power Agency, November 5, 1985.
[73] *Op cit*, footnote 2, Tenebaum et al.

interest.[74] For example, prior to National Grid Company's (UK) public offering over a year ago, it was owned by 12 RECs. Their ownership of equity does not give them right to own or resell specified amounts of transmission capacity. To ensure compliance, the government owns a 'special' share in the company.

Another regulatory issue associated with third-party access is that of transmission pricing. Current transmission pricing in the US is based on historical accounting cost. Furthermore, the price is not differentiated by the distance between the seller and the buyer. In the new comparable access paradigm, both distance and true usage costs of the transmission system will have to be recovered since there would be no single owner-user of the grid. If a contract path for wheeling power is to be negotiated, there is no assurance that electricity will actually flow through that path.[75] It is, therefore, technically possible that a transmission user could have used a third party's transmission system at the latter's expense without his knowing.

A final regulatory issue that warrants an understanding is that of native load customer protection.[76] In the US, native load customers refers to the retail and wholesale customer to whom the utility has a legal or contractual obligation to supply power to meet that customer's existing and future demand. Given this definition, the bone of contention is:[77] How should transmission be priced when there is insufficient capacity to serve the competing needs of native load and third party transmission customers? As far as native load protection is concerned, the response is, more or less, straightforward. The transmission owner should not be forced to sacrifice at all its system reliability to satisfy someone else's transmission needs. This is only fair because native load customers have paid for the capital costs of the transmission lines in the rates they have paid over many

[74] *Ibid.*

[75] According to Ohm's law, current will flow through the path of least electrical resistance and according to Kirchhoff's law, the sum of currents flowing in to a node is equal to that flowing out of the node. Combined, these two laws not only defy contract paths but can also be a serious cause of load congestion in the transmission lines.

[76] US Federal Regulatory Commission, Northeast Utilities Service Company, Opinion 364-A, 58 FERC para 61 070, January 29, 1992, and Edison Electric Institute, A proposal for the appropriated pricing of transmission services, Transmission Issue Monograph, No 4, May 1992.

years.[78] This is also efficient because it ensures that the limited transmission capacity is used for those power sales that produce the greatest benefits. In the US, pricing based on foregone benefits to the transmission owner is called opportunity cost pricing.[79] FERC has stated its willingness to accept transmission tariffs that include 'legitimate and verifiable' opportunity costs.[80] What constitutes a reasonable opportunity cost is a question that would need to be resolved by regulators, utilities and industry practitioners.

2.5.4 Industry Model 4

As described earlier (see Section 2.2), model 4 involves total separation of generation from transmission and distribution. We specifically focus on the UK experience in this section for two reasons: First, it provides us with an operational prototype of this model. And second, sufficient literature on the British privatization and restructuring experience does exist to make a reasonable assessment of this model. We will focus on four particular issues here. A fifth issue—the use of a spot market backed by hedging contracts as the basic competitive mechanism—was discussed earlier (see Section 2.3.5).

Concentrated generation sector

Up and till a couple of years ago, the newly privatized generation sector was highly concentrated with the two big companies, National Power and PowerGen, owning nearly 70% of the total generating assets.[81] With their current market power and direct access to retail consumers, not only could they manipulate the spot market, they could also subsidize their retail and wholesale businesses from the revenues of their generation business.

The degree of concentration, however, has decreased with new private companies and IPPs collectively generating more than one-thirds of the total energy today.

---

[77] *Op cit*, footnote 2, Tenebaum et al.
[78] *Ibid.*
[79] US Federal Regulatory Commission, Northeast Utilities Service Company, Attachment B, 57 FERC para 61 340, December 15, 1992.
[80] *Op cit*, footnote 75, Opinion 364-A.
[81] *Op cit*, footnote 2, Tenebaum et al.

Moreover, National Power and PowerGen have also been "told" to sell off some of their assets voluntarily.[82]

The reintegration problem

While new entering IPPs dilute the market power of existing dominant companies, many of them are actually affiliated with their buyers, the RECs, and are not truly independent IPPs.[83] The RECs rightfully argue that their ownership of equity in the new generators allows them to reduce the dominance of the two big generators. This argument, however, ignores other effects. For example, whenever a regulated buyer has captive customers, it has the incentive to purchase from its unregulated affiliate at a price that is higher than the market price. Captive customers would end up paying more unless the regulator can correct this inefficient outcome by enforcing economic purchase license duties.

End of the captive retail market

By 1998, every customer in Britain down to the smallest residential consumer will have the right to buy from any supplier in the country.[84] This total freedom to choose suppliers may influence operating investment and operating decisions in three possible ways.

The first effect is that of asymmetric obligation on stranded investment. While RECs' customers will have total freedom to choose other suppliers, the RECs will continue to have a permanent legal obligation to supply electricity to any customer within a specified geographic area that has a maximum demand of 10 MW or less.[85] In non-regulated markets, sellers and buyers have no legal obligation to do business with each other.

This kind of asymmetric obligation on the RECs leads to uncertainty. The proportion of customers who will continue their allegiance to their old REC depends partly on the costs of switching to another supplier and partly on the REC's price vis a vis

---

[82] Personal communication with Richard Tabors, thesis co-advisor.
[83] *Ibid.*
[84] *Ibid.*
[85] *Ibid.*

that of other suppliers.[86] If the REC overestimates its demand, it runs the risk of running losses by paying fixed obligations incurred in hedging contracts.

The second effect relates to the duration of contracts signed between suppliers and the new non-captive customers.[87] The conventional wisdom is that IPPs need long-term purchase agreements (i.e., 15 years or more) to obtain project financing for new generating projects. Under the non-captive customer provision since buyers would not want to sign longer duration contracts, the option of project financing may disappear. The possible entrants in the generation sector would, therefore, be limited to larger companies that are capable of financing projects based on their balance sheets.[88]

A third possible effect of retail access is that because the risks are now transferred from few RECs to several IPPs—selling to many different customers who sign contracts of different durations—the need to group the demand of many different customers with dissimilar demands will raise transaction costs.[89]

2.6 **Conclusion**

Against the backdrop of poor financial, managerial, and operating performances of developing country electric utilities and their inherent inability to muster sufficient investment capital, we surveyed various options and models of current industry structure, competition, and regulation by primarily drawing upon the experiences of the UK and USA. Private ownership of divested public assets backed by competition—sufficient to challenge market power—and minimal regulation would be an ideal combination for a growing electric industry.

If UK's privatization experience offers us any lesson, it is this: Where politically feasible, the preferred approach would be to put the industry and regulatory structures in

---

[86] *Ibid.*
[87] *Ibid.*
[88] *Ibid.* While we will explore drawbacks of project financing from a developing country perspective, it is interesting to note that complete deintegration with retail access, regardless of a country's developmental stage, will require balance-sheet or corporate financing to assure a leveled playing field.
[89] *Ibid.*

place prior to privatization.[90] This is what is being carried out in Australia and New Zealand. If this is politically infeasible, the alternatives is to do what the British did—restructure and privatize at the same time. However, there are two potential problems with the British approach: First, once the structure is in place, it is difficult to correct these mistakes. After new private companies come into existence, they will naturally oppose any further changes that would hurt their property rights. The reality is that it is much easier to make changes before privatization than to do so afterwards.[91]

Second, it may be better to restructure before privatizing from the context of attracting private investment. With the worldwide movement towards privatization, there is enormous competition for private capital. It is axiomatic that investors require higher returns when they perceive more risk. Uncertainty increases risk. If a country wants to get a reasonable price for a government owned electricity system, it must provide some certainty about the new rules of the game.[92]

The next step in our discussion is to appraise the current industrial and ownership structures of electricity service provision in developing countries and examine their impacts on service performance. The extent of power system deintegration, i.e., the shift from Model 1 towards Model 4 of the industry structure, is a reasonable indicator of a government's willingness to introduce competition among service providers and of its institutional capacity to regulate or deregulate them.

Similarly, based on the economic principles laid out in the preceding chapter, the degree of private-sector involvement in energy service provision may serve as a gauge for the government's commitment to promote private capital in infrastructure development and to improve upon the existing level of service performance.

Against this background of economic and performance realities and options for restructuring the electric utilities, we examine in the following chapter whether private-sector involvement is as important as competition for improving service quality and

---

[90] *Ibid.*

[91] Horton, Geoff, *Competition and antitrust legislation in the electric power sector*, Seminar on current issues in regulation, World Bank, May 28, 1992.

[92] Clements, Phillip J., *Valuation issues in lesser developed countries investment opportunities*, Coopers and Lybrand, New York, March, 1992.

operational efficiency of electricity provision. This becomes a crucial distinction when we observe some governments from industrialized nations continuing to own and operate electric utilities efficiently while those from developing countries are anxious to privatize public monopolies without giving much thought to the overarching long-term goals and decisions.

3. OWNERSHIP VS. MULTIPLICITY: DOES OWNERSHIP MATTER?

Up to this point, we have expanded our basic tenet, that private ownership is important, to include crucial elements like structure, competition, and regulation to facilitate an economically efficient provision of electricity. This chapter, based on a World Bank research paper, takes us one step further to fine tune the role of ownership of assets vis-a-vis competition through multiplicity.[1] In essence, the paper gathers ample evidence to answer this question: Is multiplicity as important as ownership in the efficiency of electricity provision?

3.1 The Rationale

The discussion so far has been based on the premise that transfer of ownership of assets from the public to the private sector is a prerequisite to efficient provision of electricity service [see Section 1.3]. Another option that does not necessarily involve privatization is introducing multiplicity, i.e., competition, in and for service production, and devolving responsibilities to regional, state, or local authorities.[2] We need to know whether one, a combination of both, or a proper sequence of these options would lead to better provision of electricity service. This requires a methodology that measures efficiency of service delivery for different structures of provision.

Previous empirical analyses on the relative performance of services under different provision regimes have been inadequate for a number of reasons.[3] First, few of them have accounted for the combined effects of ownership and multiplicity. Second, the analyses have mostly considered profitability as the sole indicator of efficiency, and have

[1] Humplick, Frannie, *Does ownership matter more than ownership in the efficiency of Infrastructure services?*, Editors: Batten, D.F., and Karlsson, C., *Infrastructure and the complexity of economic development*, Springer, 1996.

[2] *Ibid.*

[3] *Ibid.*

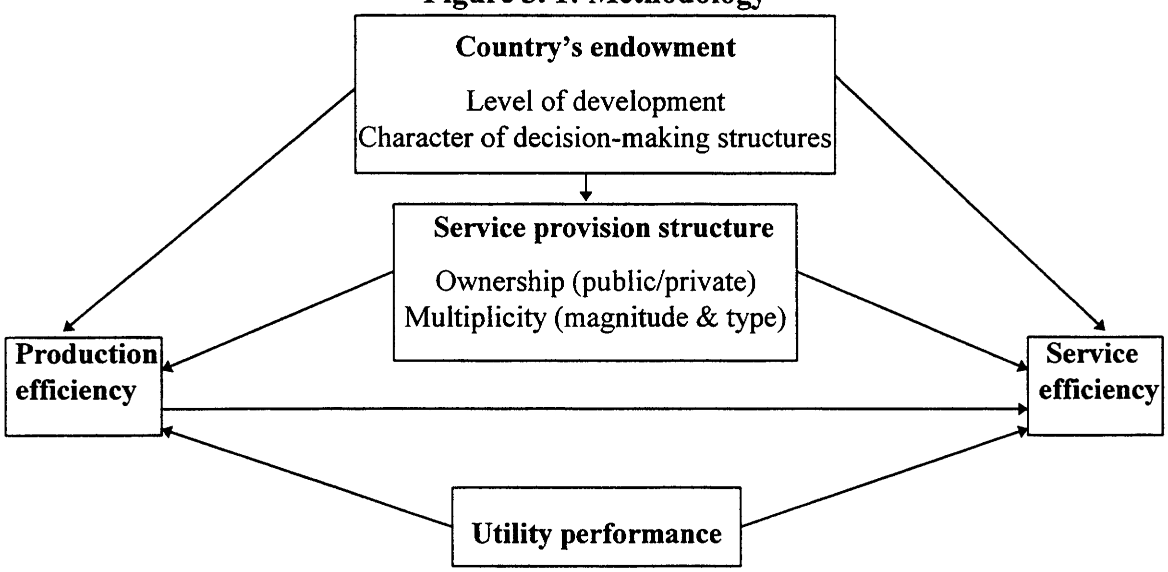
generally ignored operational efficiency indicators. And third, the effects of a region's development level on the performance of service provision under different provision regimes have not been systematically studied.

The research paper cited above explores the relative advantages of one provision regime over another over a range of efficiency indicators while controlling for the level of development. A model relating to the electricity provision variables of ownership and multiplicity to production and service efficiency measures is presented. A 100 country database has been used for the analysis.[4]

3.2 Methodology

At the simplest level, the relationship between service electricity provision

Figure 3. 1: Methodology



Source: Humplick (1996)

structure and infrastructure performance can be depicted as in Figure 3.1. A country's endowment—characterized by its level of development and the character of its decision-making structures—is represented as an endogenous effect determining the existing provision structures in a country and regulating or controlling the levels of performance

[4] While Humplick has used 1988 power data in her analysis, I have used 1991 data; but, the methodology remains the same as was used in the original study.

of a typical utility providing infrastructure services.[5] The service provision structure includes the types of ownership and the level of multiplicity involved in service provision. Both production efficiency and service efficiency are benchmarks of utility performance. Utility performance itself is decided by the combined effects of the structure of service provision and the country's endowment.

3.2.1 Multiplicity, Country's Endowment, and Utility Performance

Utility performance, as described in Figure 3.1, is determined by the structure of provision, defined along dimensions of ownership and multiplicity, and the country's endowment defined by the achieved level of development and the decision-making structures within a country. We have gone to considerable depths in understanding the ramifications of public and private ownership. Acknowledging that ownership matters in the efficient provision of service, we directly turn our focus to the other component of the structure of service provision: multiplicity.

3.2.1.1 Multiplicity

As shown in Figure 3.1, multiplicity is defined in terms of magnitude—the number of independent actors involved in service provision—and type, distinguishing between vertically and non-vertically integrated production systems.[6] With more number of players vying for service provision, we would expect that corporate information and decisions will become more transparent. By the same argument, these players ought to be more inclined to compete for improved services. Moreover, the multiplicity of relationships resulting from administrative processes governing relationships between users and producers, regulators and producers, and users and regulators affects the efficiency.[7] For example, with more number of service providers, the size and complexity of such relationships may lead to inefficiencies. It has been found that in sectors undergoing rapid technological change or characterized by extreme uncertainty, the size and complexity of administrative functions governing the provision of service are

---

[5] *Op cit,* footnote 1, Humplick.
[6] *Ibid.*
[7] Spulberg, D., *The Market and Regulation*, The MIT Press, Cambridge, 1989.

credited for deciding between success and failure.[8] The degree of consistency in carrying out these administrative functions also significantly impacts the role of multiplicity.

The type of multiplicity may affect the efficiency of service provision in two ways.[9] First, a service provider with the sole vertically integrated production system—translated to single multiplicity—has little threat of competition and is, therefore, less likely to disclose its financial information and decisions. Second, vertical integration, favored for its reduction in working capital, elimination of relatively high transaction costs, and acquisition of 'secure' markets can also be a notorious source of monopoly profits. Under these circumstances, the degree of multiplicity may be increased without losing the benefits of vertical integration by introducing vertically integrated regional monopolies [see Section 2.5.1].

3.2.1.2 Country's Endowment

A country's endowment—consisting of its level of development and character of decision-making bodies—has an important bearing on its infrastructure's ability to provide efficient service. The level of development, for instance, determines two important components that can affect the type and efficiency of service provisions.[10]One of them is the amount of resources (labor, capital, and technological expertise) available for allocation among competing provision activities. The other component is the country's capacity to manage large-scale activities.

Applying these factors to an under-developed economy, the generally lower levels of education and inadequate skills, and scant public financing of long-term infrastructure maintenance, in particular, are most likely to downgrade the quality of service provision.

---

[8] Levy, B. and Spiller, P.T., *Regulations, institutions and commitment in telecommunications: A comparative analysis of five country studies*, presented at a seminar on Institutional Foundations of Utility Regulation: Research Results and their Operational Implications, The World Bank Group, Watergate Hotel, Washington, D.C., 1993.

[9] *Op cit*, footnote 1, Humplick.

[10] *Ibid.*

Moreover, empirical studies have shown a clear correlation between the level of development (as measured by per capita GNP) and efficiency of service provision.[11]

The other variable affecting provision structure is the character of decision-making structures defined by the nature and degree of accountability and transparency of information and decision flows; particularly the nature of liberties.[12] Empirical evidence suggests that political and civil rights are positively and significantly correlated with real national income per head and its growth.[13] After controlling for income growth and regional effects, liberties appear to be strongly and positively associated with measures of overall education.[14]

Indicators of political and civil liberties have been developed by Gastil.[15] The Gastil index is based on a ranking of countries according to thirty specific tests under two criteria: political rights defined as 'rights to participate meaningfully in the political process'; and civil liberties defined as 'rights to free expression, to organize and demonstrate, as well as rights to a degree of autonomy'.

For each of the above criteria, Gastil has developed an index. The GAS-POL index amalgamates various indicators such as: (a) universal suffrage, (b) the right to compete in the political process, and (c) the right for elected officials to have a decisive vote on public policy. For a country to score high on the GAS-POL index, it must have a fully operating electoral procedure, usually including a significant opposition vote.

Similarly, the civil liberties index, GAS-CIV, is designed to measure the extent to which people are able to express their opinions openly without fears of reprisals and are protected in doing so by an independent jury. Primary attention is given to those liberties

---

[11] Queiroz, C. and Gautam S., *Road infrastructure and economic development: Some diagnosis indicators*, Working paper, The World Bank, 1992.
[12] World Bank, *World Development Report: The challenge of development*, Oxford University Press, 1991
[13] Dasgupta, P., *The state and the idea of well-being*, Economic Journal, Vol 100,4: supplement, 1990.
[14] *Op cit*, footnote 12, World Bank.
[15] Gastil, R., *Freedom in the world*, Freedom House, New York, 1989. The methodology has been modified since Gastil's index formulation in subsequent Annual Surveys of Freedom Country Scores by Freedom House. See http://www.freedomhouse.org/survey.htm for more details.

which are more directly related to the expression of political rights, with less attention given to those liberties that are expected to affect individuals in their private capacity.

3.2.1.3 Utility Performance

Infrastructure performance may be analyzed at three levels[16]: (1) at the level of the beneficiaries as measured by service quality or service effectiveness; (2) at the level of internal operations of the entities producing a service as measured by operational or managerial efficiency; and (3) at the sectoral level where size and growth in investments in infrastructure are important. Humplick's paper focuses primarily on the first two levels.

At the first level, measures of unsatisfied demand or service interruptions can be used as reliable surrogates of service quality. In the electricity industry, system losses, voltage fluctuations, loss of load probability (LOLP) are examples of such measures. At the second level, measures of operational efficiency may be categorized as follows: (a) labor productivity (e.g., number of customers per employee); (b) proficiency in extending services to customers (e.g., GWh/customers, percentage access to service, generation capacity factor), and (c) responsiveness to new demand (e.g., availability of new service types such as data transmission capabilities in telecommunications).[17]

The two levels of utility performance have a cause and effect relationship. Low operational efficiency of a utility may manifest as poor service qualities in the short run and long run. Poor service quality, in turn, affects the customer's willingness to pay and their degree of loyalty to the mode of service provided by the utility. For example, the customer may be willing to switch to a more reliable alternative even if it means paying more for it. Sustained levels of poor service quality would eventually erode the available customer and revenue base of a utility.[18]

Private enterprises or highly autonomous public entities that run on commercial principles have an explicit and direct relationship between operational efficiency and

---

[16] *Op cit*, footnote 1, Humplick.
[17] *Ibid.*
[18] *Ibid.*

service effectiveness.[19] In other words, an enterprise with a low operational efficiency over sustained periods of time will not be able to maintain service quality levels, and is likely to go out of business unless it is propped up by government subsidies. Managers of public enterprises, on the other hand, face objectives—often politically motivated—beyond cost-effective service provision. [see Sections 1.2.7 and 1.3.1]. What inevitably results is an ambiguous and indirect relationship between service quality and operational efficiency. In any analysis it is, therefore, imperative to specify the joint or independent effects of operational efficiency and quality of service provision.

3.3 Model Specification

The different variables described in Figure 3.1 are summarized in the simultaneous equations below:[20]

$$
\begin{aligned}
Y &= \Psi(W) \\
S &= f(X, Z) + \xi \\
X &= g(Y, W) + \varepsilon \\
Z &= h(X, Y, W) + \eta
\end{aligned}
\tag{1}
$$

where

W = exogenous variables affecting the electric utility's performance that derive from a country's or region's endowment (level of development and nature of decision-making environment);

S = performance profile of the utility, which is a function of the relative weights given to operational efficiency and service quality;

X = indicators of operational efficiency such as labor productivity and profitability;

Y = indicators of the structure of provision, which may be a combination of ownership and multiplicity, and which may interact with the indicators of a country's endowment (level of development and nature of the decision-making environment);

[19] *Ibid*, This is primarily a result of their dependence on the user for their profitability.
[20] *Ibid.*

$Z =$ indicators of service quality or precursors to declines in service quality;

$\xi, \varepsilon, \eta =$ random terms; and

$f, g, h =$ suitably specified functions.

There are four types of relationships in equation (1). These are: (i) a structural equation relating the development climate to the structure of service provision within a country—this includes the percentage of public ownership of infrastructure assets and the type and consistency of the administrative procedures governing service provision; (ii) a measurement equation relating the indicators of performance and their respective weights to form a performance profile S; (iii) a structural equation separating out the relative contribution of a country's endowment and the structure of provision on the achievable and sustainable level of operational efficiency; and (iv) a structural relationship for evaluating service quality outcomes under different provision structures, development climates, and achieved operational efficiency. [Figure 3.2]. Two reduced form models from the structural relationship of Figure 3.2 can be generated from the two dimensions of performance: X and Z.[21]

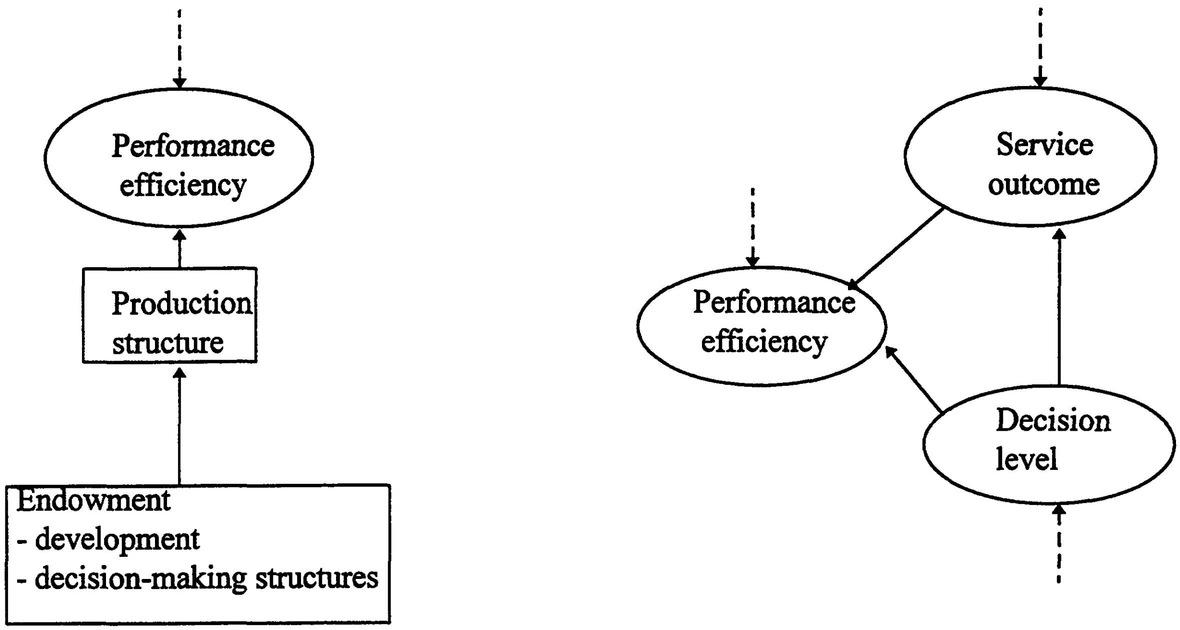
$$Z = \alpha + \beta X + \gamma Y + \delta W + \eta$$
$$X = \alpha + \gamma Y + \delta W + \varepsilon \qquad (2)$$

The relationships in equation (2) include: (i) the measurement of performance through direct variables Z of service customers as perceived by a user, and variables affected by decision flows X taken by service producers in day to day operations; and (ii) the limitations imposed on achievable performance by the prevailing structure of provision Y and the country's endowment W. Equation (2) thus implicitly captures the structural and measurement effects presented in the first two models in equation (1) [Figure 3.3].

A specific application of this model to the provision of power is shown in Figure 3.4. Performance is measured by three indicators of operational efficiency and one precursor to poor service quality. The number of customers per employee, denoted by x_1, is used as a measure of utility efficiency from the consumers perspective. Other measures

[21] *Ibid.*

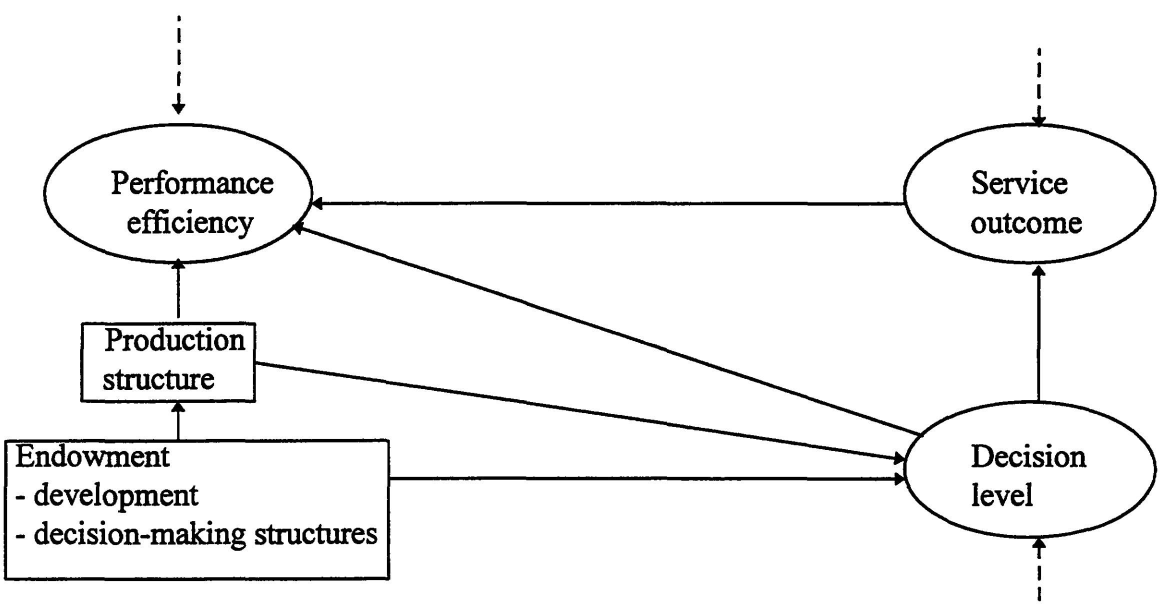
Figure 3. 2: Structural and Measurement Relationships



Structural relationship

Measurement relationship

Figure 3. 3: Full Model Specification



Source: Humplick

of production efficiency are the generation capacity factor, denoted by x_2, and the number of employees per GWh produced, denoted by x_3. The generation capacity factor indicates the extent to which installed capacity is used in generating electricity. It is computed according to the formula:

$$\text{Generation capacity factor} = \frac{\text{Gross output (GWh)} * 1000}{\text{Installed capacity (MW)} * 8760\ \text{(h)}} *100\%$$

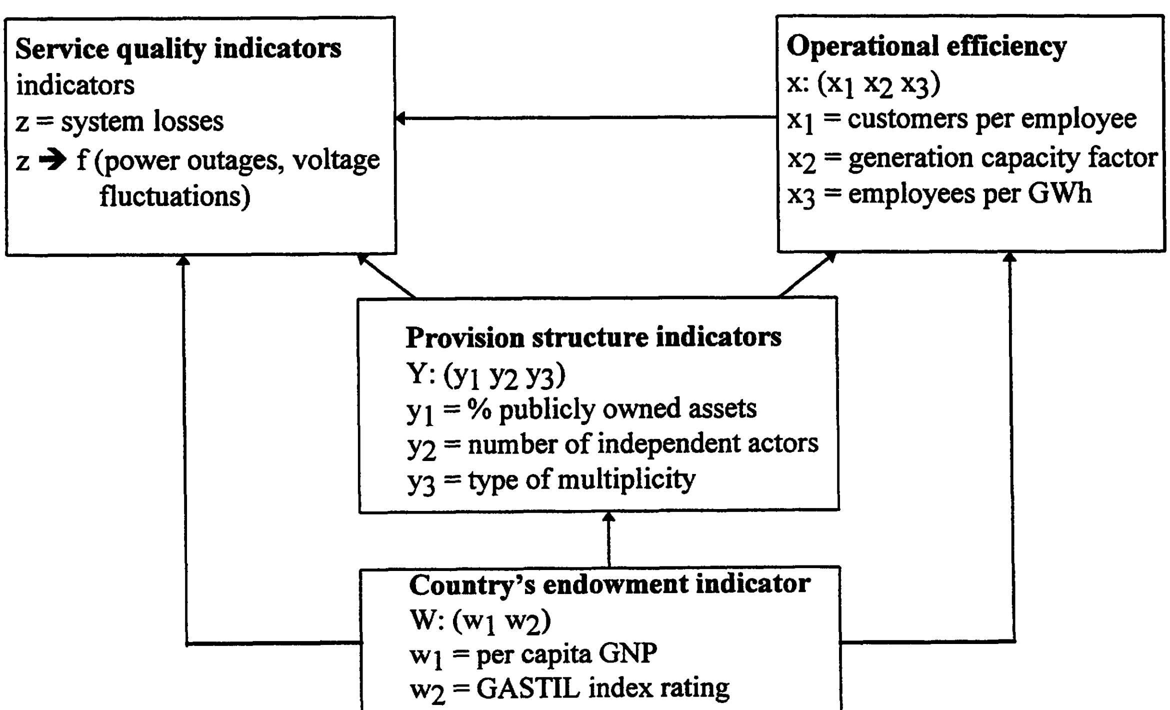
A variable termed system losses and denoted by z, is used as a surrogate for service quality. System losses are defined as:

$$\text{System losses} = \frac{\text{Net generation - Total sale}}{\text{Net generation}}$$

System losses consist of two components: technical and non-technical losses. Technical losses are attributed to the resistive losses caused by electrical current flowing through a wire. These losses are generally constant for a given network of transmission and distribution lines. Non-technical losses—the more worrisome component—include illegal consumption of electricity and poor revenue collection. System losses, in effect, reflect both service quality and operational efficiency.

The structure of provision shown in Figure 3.4 is represented by three variables:

Figure 3. 4: Application to the Power Sector



Source: Humplick (1996)

The indicator of ownership is denoted by y_1 and defined by the percentage installed capacity which is publicly owned;[22] where installed capacity refers to the rated capacity as stated on the nameplate of the equipment in a power plant. The installed capacity differs from the available capacity in that the latter is a function of equipment efficiency.

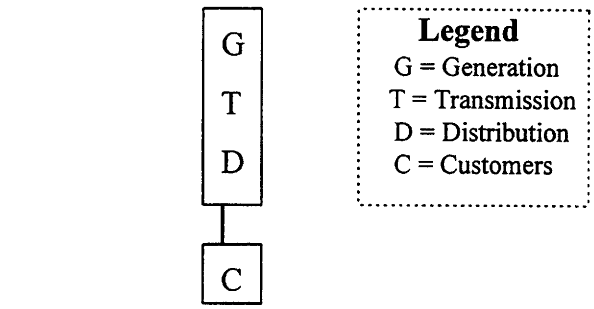
Multiplicity is represented by two variables denoted by: (i) y_2, which represents the magnitude of multiplicity as measured by the number of independent actors involved in service production; and (ii) y_3 representing the type of multiplicity which is based on the industry structure in use. The type of multiplicity found in the electric industry is summarized in Figure 3.5.[23] For the purpose of the analysis, the different structural arrangements are listed below with the numbers representing the multiplicity type index:

(1) National integrated monopoly in charge of generation, transmission, and distribution.
(2) Regionally integrated monopolies in charge of generation, transmission, and distribution.
(3) National generation and transmission, with regional distribution monopolies.
(4) Competing generation, national transmission with generation, and regional distribution monopolies.
(5) Competing generation, national transmission, and regional distribution monopolies.
(6) Competing generation, national transmission, regional distribution monopolies competing with generators.

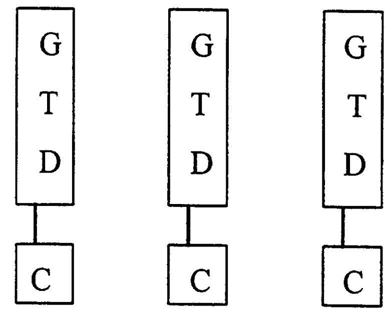
The endowment variables affecting the structure of provision and included in the analysis are: the level of development achieved, represented by per capita GNP and denoted by w_1, and the nature of the decision-making in a country represented by the GASTIL index—varying between one (most democratic/free) to seven

[22] The term 'public' comprises the undertakings whose essential purpose is the production, transmission and distribution of electrical energy. These may be private companies, co-operative organizations, local or regional authorities, nationalized undertakings or government organizations. In contrast, 'self-producers' includes undertakings which, in addition to their main activities, themselves produce (individually or in combination) electrical energy intended, in whole or in part, to meet their own needs. See *Energy Statistics Yearbook 1994*, United Nations, 1996.
[23] Besant-Jones, J.E., *Reforming the policies for electric power in developing countries*, Industry and Energy Department, The World Bank, 1992.

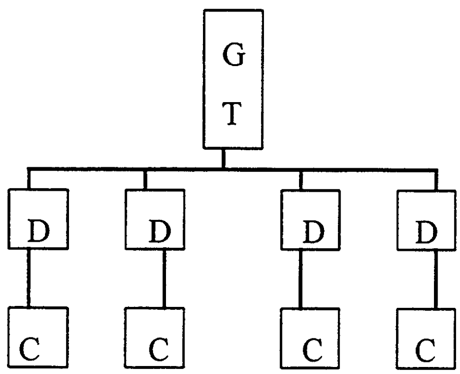
Figure 3. 5: Generic Structural Models for Power Industry Structure



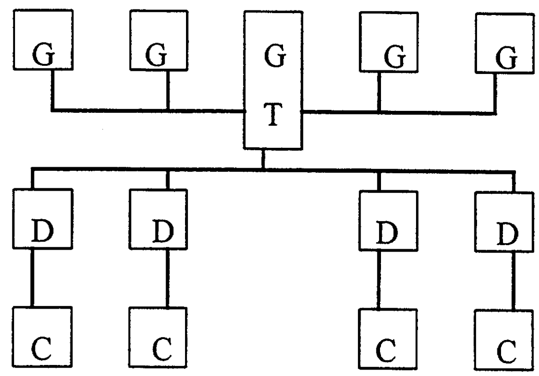
Model 1: National Integrated Monopoly



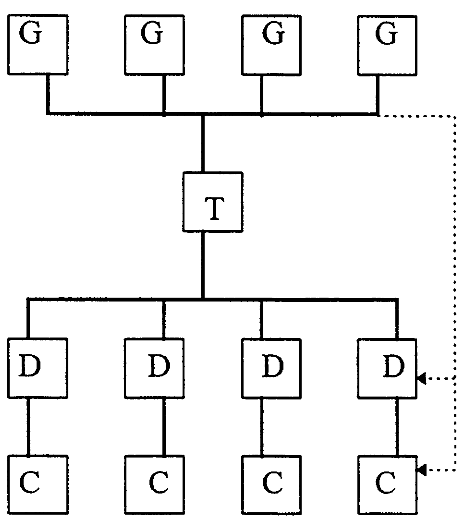
Model 2: Regional Integrated Monopolies



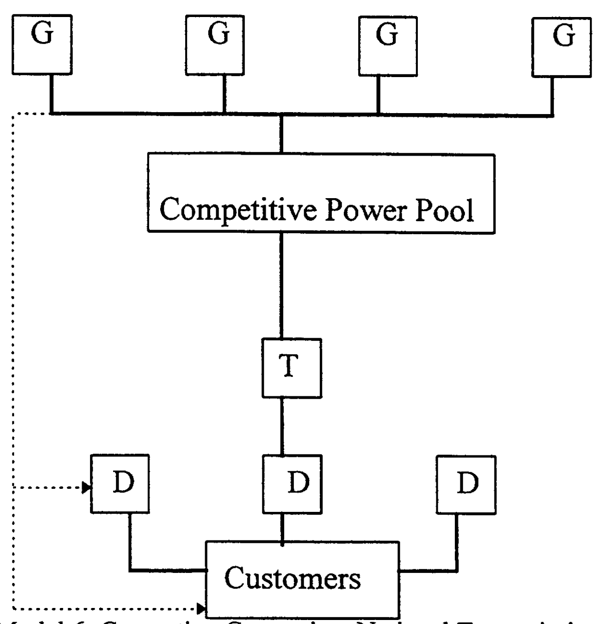
Model 3: National Generation and Transmission, with Regional Distribution Monopolies



Model 4: Competing Generation, National Transmission with Regional Distribution Regional Monopolies



Model 5: Competing Generation, National Transmission, Regional Distribution Monopolies



Model 6: Competing Generation, National Transmission Regional Distribution Monopolies, competing with with Generators.

Source: Besant-Jones

(least democratic/free)—denoted by w_2.[24]

3.4 **Analysis**

The data set used to estimate the relationships in equation (1) and to quantify the relationships between Figures 3.1 through 3.5 included in a collection of performance indicators from 96 developing countries. The purpose for using the data was two-fold: (i) to confirm the structure of the model that postulates a two-level relationship between precursors to poor service quality and operational inefficiency; and (ii) to measure the size and statistical significance of postulated effects. Binary investigations between sets of variables are used for the first objective while two-stage least squares to estimate equation (2) using the indicators defined in Section 3.3. The results are summarized in Figures 3.6 through 3.11 and Appendices 6.2 through 6.6, respectively.

3.4.1 Performance and the Structure of Provision

A relationship between system losses—a measure of service inefficiency—and the structure of power infrastructure is depicted in Figure 3.6. Despite wide scatter, we see that system losses decrease as the percentage of public ownership increases.

Strictly speaking, the definition of public ownership from data sources available does not differentiate among nationalized undertakings, joint or independent stock-holding companies, or private providers [see Footnote 22]. It would, however, be reasonable to assume that low-income developing countries have a predominance of federally- or state-owned electric utilities and transmission systems.

A similar plot relating the percentage system losses to the magnitude of multiplicity shows the same degree of scatter with a definite declining trend in losses [see Figure 3.7]. This plot indicates that, as the magnitude of multiplicity increases, by having more actors involved in service provision, the degree of service inefficiency decreases (lower system losses). The amount of scatter observed in Figure 3.7 could be attributed to the size and complexity of the decision-making environment. The type of multiplicity—as measured by the six production structures in Figure 3.5—also appears to have a slight

[24] *Op Cit*, footnote 1, Humplick.

Figure 3. 6: System Losses and the Structure of Ownership

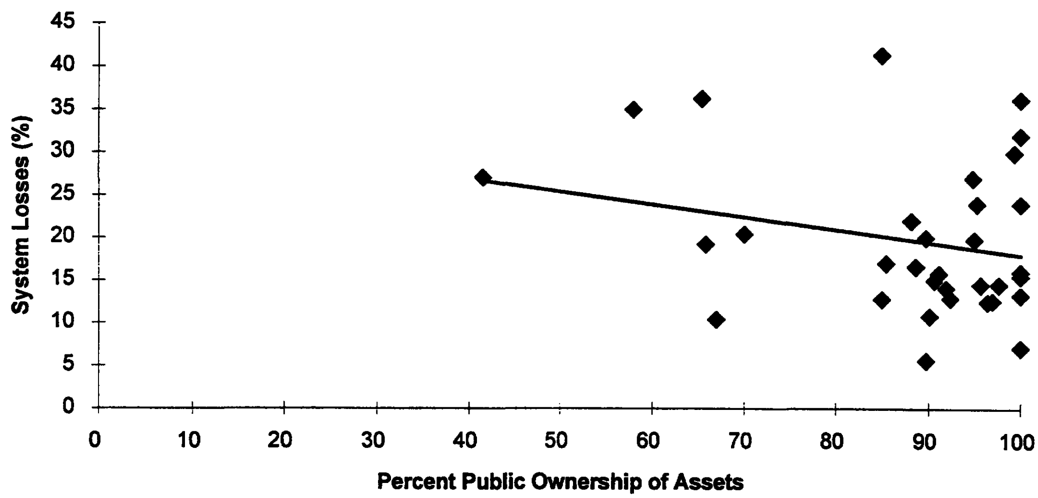
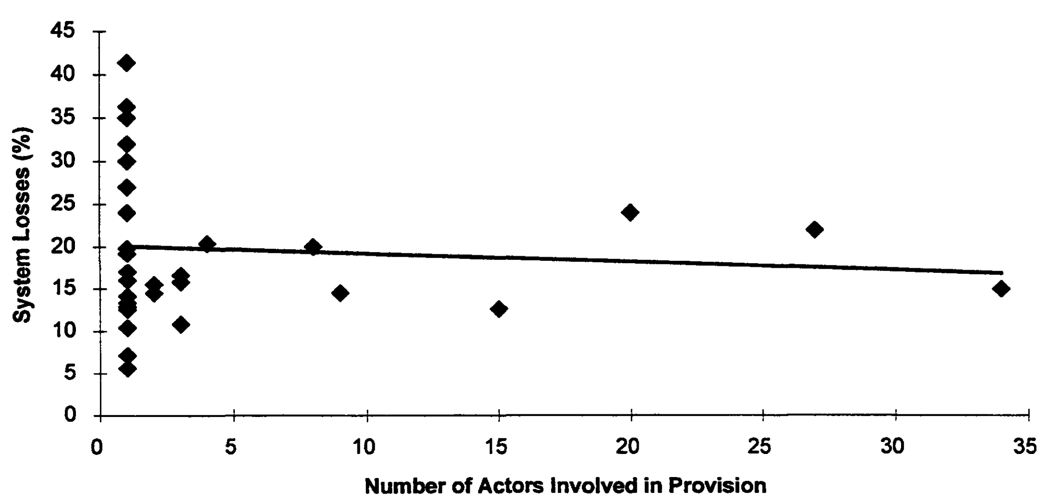


Figure 3. 7: System Losses and the Magnitude of Multiplicity



negative correlation with system losses [see Figure 3.8]. As we shall see in our two-stage least-squares estimate, a country's endowment appears to be a significant deciding factor of system losses. Figure 3.9 shows the effect of the type of multiplicity on production efficiency—measured by the number of customers per employee. In this figure, as in Figures 3.6, 3.7, and 3.8, there is a lot of scatter and the correlation between the two variables is negligible.

The above results indicate that a binary relationship between production structure and performance is not sufficient to capture the main effects. A joint estimation of the models in equation (2), as is presented later in this section, allows us to extract the main effects which remain hidden in binary representations such as those shown in Figures 3.6 through 3.9.

3.4.2 Performance and a Country's Endowment

The effects of variables such as per capita GNP and the GASTIL index was also investigated as shown in Figures 3.10 and 3.11. These figures indicate that the countries with higher levels of development have, with a lot of scatter, more efficient services (see Figure 3.10). Reduction in the transparency of decision-making, as measured by a high GASTIL index, induce declines in performance, as demonstrated by increasing system losses with reductions in the transparency of decision-making (see Figure 3.11).

3.5 **Estimation Results**

To confirm and explicitly measure the size of the effects depicted in the last two sections, a two-stage least squares estimation of the models in equation (2) was performed. The results are summarized in the Appendix (Table 6b) and the details of each estimation presented in Tables 6d, 6f, 6h, and 6j. Estimation results of Humplick's original analysis based on 1988 data have also been presented in Tables 6c, 6e, 6g, 6i, and 6k for comparison. From Table 6b, we see that the effect of ownership has a negative and significant relationship (at 90% confidence level) with system losses. Other operational efficiency variables such as production efficiency—as measured by generation capacity factor, x_2, and employees per GWh produced, x_3—are not

Figure 3. 8: System Losses and Type of Multiplicity

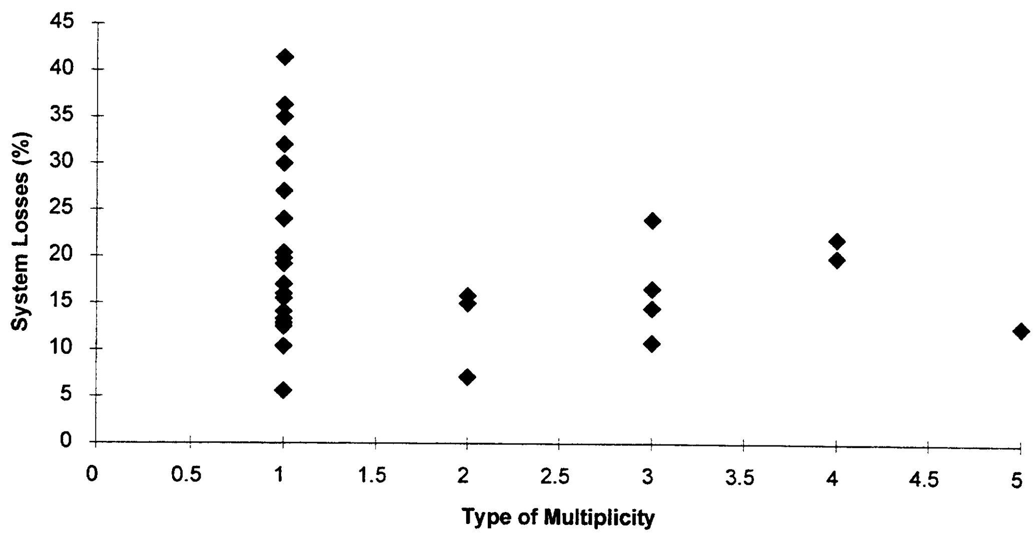
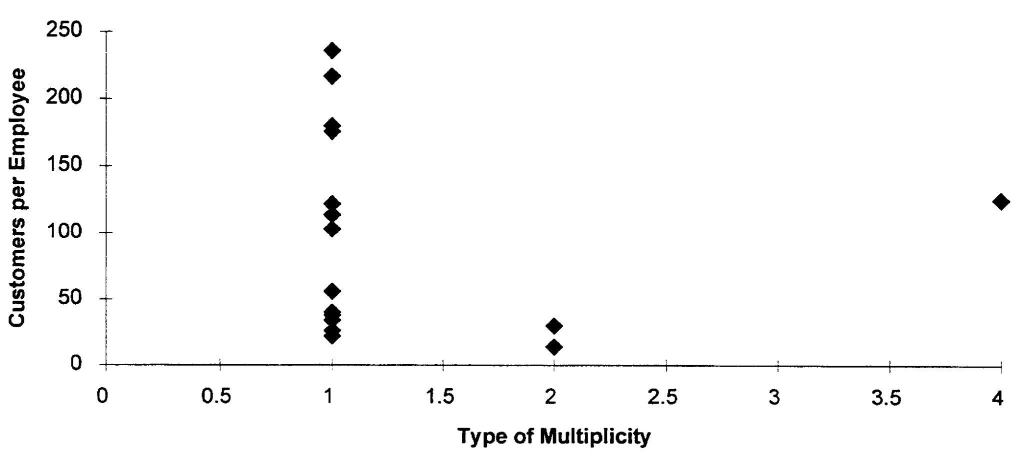


Figure 3. 9: Type of Multiplicity and Production Efficiency



significantly affected by percent public ownership.

The above effects of ownership, however, contrast sharply with the 1988 results as shown by Table 6c. The correlations are opposite to those of the original analysis. For instance, system losses is positively correlated with public ownership in the earlier results. Similarly, employees per GWh decline with increased public ownership.

Unlike the sharp differences in ownership effects, the effects of multiplicity—both type (y_2) and magnitude (y_3)—appear to be more strengthened in 1991. Both of these variables have significant relationships with customers per employee, x_1. In 1992, however, the previously positive correlation between y_3 and x_1 is now negative.

The impact of per capita GNP—surrogate for managerial capacity—on system losses, customers per employee, and employees per GWh are statistically significant at 90% significant levels and higher in 1991 (Table 6b). From 1988 analysis, we observe that per capita GNP also had significant relationship with generation capacity factor (Table 6c).

The decision-making endowment, measured by w_1, has a negative and significant relationship with system losses, z, in 1991 while that for 1988 was positive and significant. Moreover, in contrast to 1991, w_1 had significant relationships with generation capacity factor (x_2) and employees per GWh produced (x_3) in 1988.

Examining the detailed estimation results for 1991 and 1988, we see that both analyses converge at the negative and significant z-w_1 relationship. This relationship suggests that the greater the managerial capacity of a service provider, lesser its service quality (Tables 6d and 6e). Apart from this, the other variables—namely y_1 and w_2—have inconsistent relationships with z for the two different years. Combining these effects, it may be said that the decision-making environment (w_2) and structure of ownership (y_1) are not as important determinants of service quality (z) as managerial capacity, indicated by per capita GNP (w_1).

As seen from Tables 6f and 6g, no variables significantly affected operational efficiency, indicated by customers per employee (x_1), in 1988; however, in 1991, multiplicity variables figure very prominently in the analysis. A higher magnitude of

Figure 3. 10: Level of Development and Efficiency

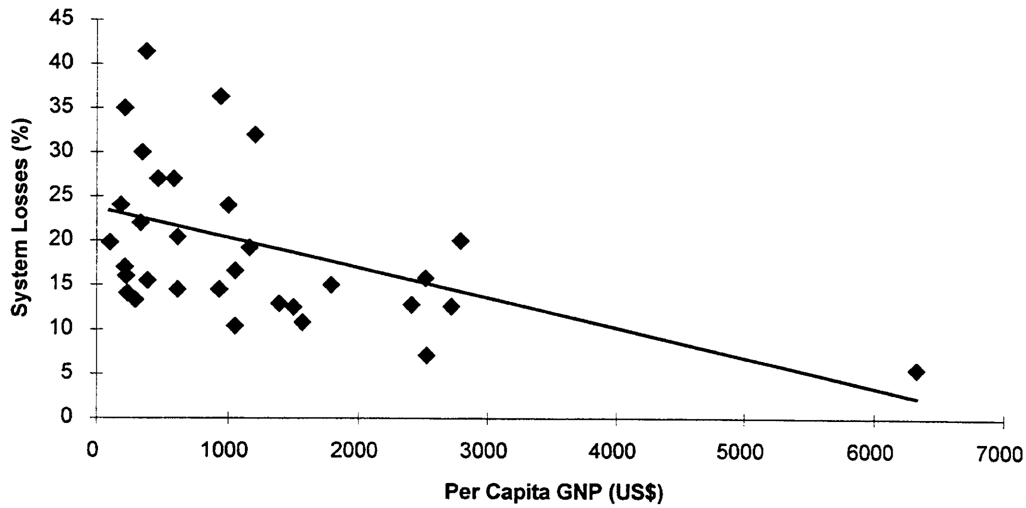
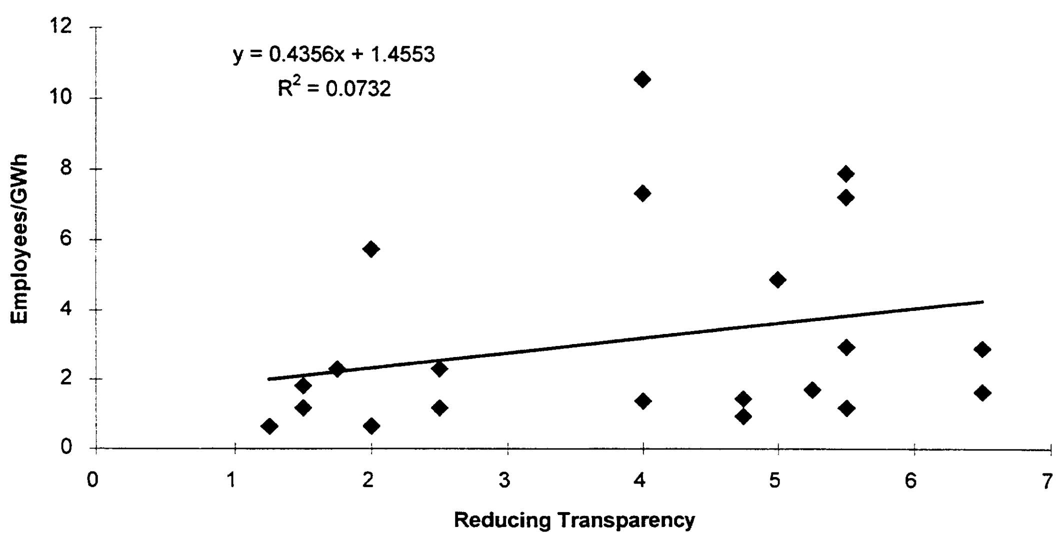


Figure 3. 11: Decision-making Endowment and Production Efficiency



multiplicity (y_2)—through increased competition—seems to lead to a definite increase in the customers per employee. The effect of systems unbundling—indicated by the type of multiplicity (y_3)—however, changes sign and significance between 1988 and 1991. This inconsistency may be explained as follows: Utilities that moved towards unbundling their power systems since 1988 may not have necessarily downsized their staffs, particularly where no divestitures of public assets are involved. Alternatively, an unbundled portion—generation, transmission, or distribution—of a utility is likely to have access to fewer customers on average at least during the transition period.

In 1991, no variables appear to have a statistically significant relationship with operational efficiency—as measured by generation capacity factor (x_2) (Table 6h). This is in sharp contrast from 1988 when the country's endowment (both per capita GNP and decision-making environment) had strong effects on generation capacity factor (Table 6i). Combining these results, we see the predominance of managerial and regulatory capacity over ownership structure in determining the impacts on service quality and operational efficiency of energy provision.

The above conclusions are further strengthened when we observe the significant relationships between a country's endowment and operational efficiency—as measured by employees per GWh produced (x_3)—as shown in Tables 6j and 6k. Accordingly, a country with a higher per capita is likely to have lower employees per GWh produced (Table 6j). Moreover, a country with a lacking transparent decision-making environment is also likely to have more employees per GWh produced (Table 6k).

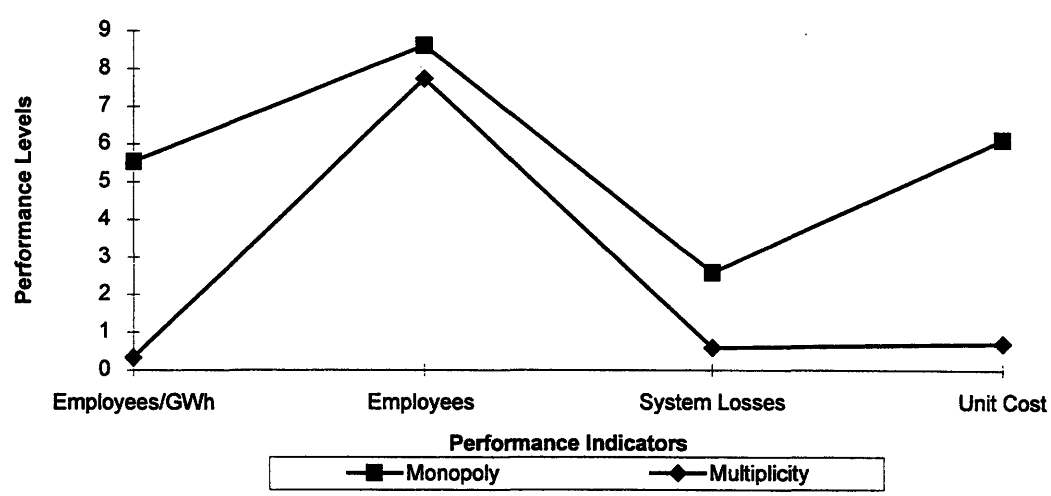
3.6 Limitations of the Analysis

The results of the analysis need to be interpreted with caution.[26] First, the choice of indicators affects the meaning of the results. For example, the inverse of labor productivity is labor intensity. When comparing across a wide range of countries, presumably with different labor costs and at different levels of development, one may be measuring a policy choice rather than true inefficiency. Second, the direction of causality assumed in this analysis also affects the interpretation. If one observes that when there are

[26] *Op Cit*, footnote 1, Humplick.

multiple providers of electricity services are more efficient by some measures, is this a result of multiplicity or that multiplicity has been possible where generation of services is more efficient? To examine this, a performance profile for multiplicity under two scenarios is constructed. The two scenarios are monopoly (multiplicity =1) and multiplicity with more than one service provider. Consider the means of a typical performance profile, $\mu'_1 = [\mu_{11}, \mu_{12}, \mu_{13}, \mu_{14}]$ representing the mean performance, say of a group of countries where the provision of electricity is through a public monopoly.

Figure 3. 12: Multiplicity under Mixed Ownership

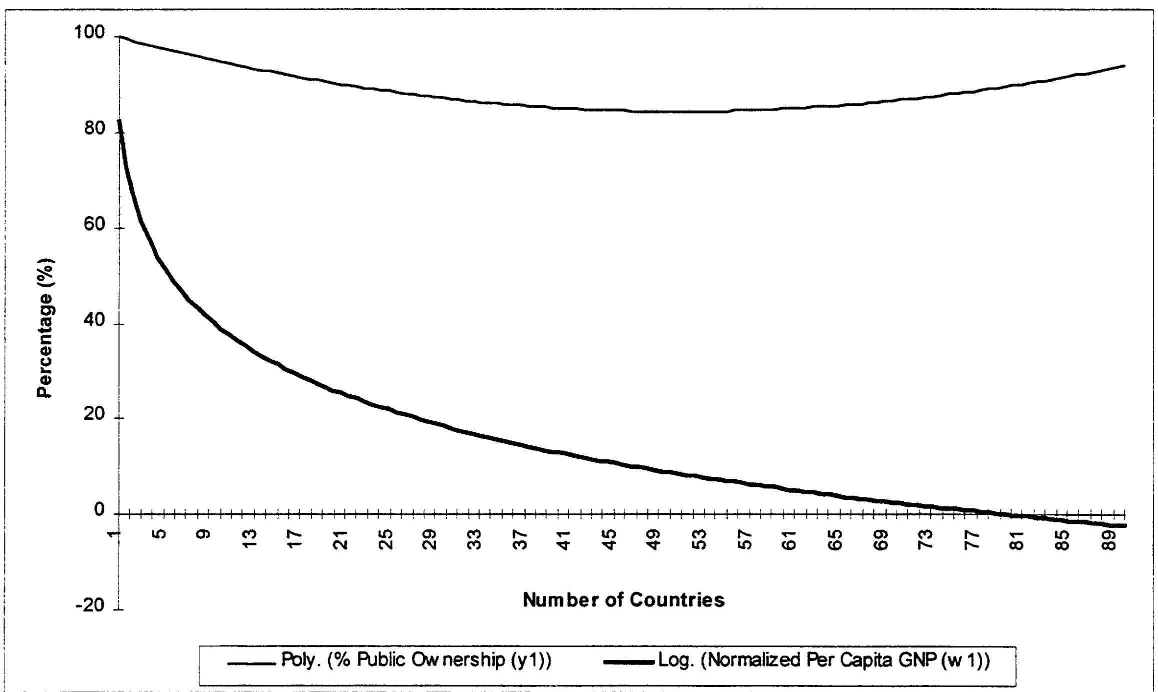


Consider another group of countries, where the provision of infrastructure is through a number of public enterprises—that is there is multiplicity. We denote the population means by $\mu'_2 = [\mu_{21}, \mu_{22}, \mu_{23}, \mu_{24}]$. Figure 3.12 shows performance profiles for both monopoly and multiplicity. The four performance indicators used are employees per GWh, number of employees, percentage system losses, and the unit cost of service provision. It should be noted that the units for each of these indicators have been normalized. A lower performance level would indicate a lower value of the performance indicators. For example, for all the performance indicators in Figure 3.12, we observe that performance is consistently better in a multiplicity environment than that in a monopoly environment. The profiles strongly support the thesis that, all other things being equal, multiplicity has a positive effect on the performance of electricity service provision.

3.7 Summary

The results of our empirical investigation can be summed up in three points: First, ownership is not as important a determinant of service quality as managerial capacity. Our discussions from Chapter 1, however, suggest that managerial capacity has found to be generally lacking in state-owned electric utilities in low income countries. How do we reconcile these two observations? Figure 3.13 may help us understand where ownership becomes an overriding concern.[27]

Figure 3. 13: Relationship between Managerial Capacity and Ownership Structure



As shown above, starting from the left-most end, managerial capacity decreases with the decline in percentage public ownership—as indicated by per capita GNP up and till approximately 10% of the base value, or $850. Below this value, percentage public

[27] Per capita GNP was normalized by taking Cyprus, the country with the highest per capita GNP (US$8640), as the base of 100%.

ownership actually increases with continued steady decline in managerial capacity. This suggests that the composition of the ownership structure of countries to the right of the curve is different from that of the left side. At this point, we refine our earlier assertion (Section 3.4.1) that low-income developing countries have a predominance of federally- or state-owned electric utilities and transmission systems by adding that countries with per capita GNP of $850 or lower are likely to fit into the "low-income" category. Accordingly, developing countries to the left of the curve are likely to have mixed or even wholly private ownership structures. In the former case, therefore, ownership does become a crucial factor and the result is usually an improvement in performance with decreasing roles for the state in electricity service provision.

Second, magnitude of multiplicity, all other things being equal, does improve the operational efficiency of electricity provision.

And finally, the most conclusive of all, the country endowment indicators are the strongest determinants of three out of the four performance efficiency parameters. An able and autonomous management to provide electricity service combined with a transparent decision-making environment go a long way in improving the quality and operational efficiency of that service.

These points have important ramifications for strengthening the basis for our discussion in the next chapter. In low income countries where managerial and institutional capacities are weak, the inflow of private capital for energy infrastructure investments may signal a need for reforms in the current provision structure. These reforms would have to include a change in the ownership structure and/or competition with an appropriate regulatory framework.

4. FINANCING STRATEGIES FOR THE POWER SECTOR

4.1 Overview

We have so far demonstrated that private ownership has the appeal of bringing in private investment in a usually capital-hungry power infrastructure sector and promoting long-term efficiency gains through effective corporate governance. Our next step is to explore the different options a developing country government or a developer has at its disposal to finance power projects. Studies have shown that private financiers are able to mobilize the funds necessary to finance infrastructure projects, and private sponsors willing to accept both project and country risks, provided that the institutional environment has met certain minimum standards and the projects appropriately structured.[1] Governments are assisting this process by creating new opportunities for private investors in an effort to bring more efficiency to project construction and operation, greater competition in the supply of infrastructure services, and greater access to international capital markets. Limited recourse project financing of power generation projects has been widely promoted as a solution to the intractable problem of getting private credit to a sector dominated by noncreditworthy borrowers and public agencies.[2] When the lights are going out, incumbent power enterprises are financially unviable, and the public purse is nearly empty, project financing of independent power producers (IPPs) may seem the only way to get new capacity fast. In the developing world, however, the public-private partnership in project-financed IPP ventures has been disappointingly slow to produce results. In the long run, however, power finance soothsayers predict increasing marginalization of project financing. In this chapter, we will marshal evidence that supports this prediction.

---

[1] Bond, Gary and Carter Laurence, *Financing private infrastructure projects: Emerging trends from IFC's experience*, IFC Discussion Paper No. 23, IFC, 1994.

[2] Jechoutek, Karl G. and Lamech, Ranjit; *Private Power Financing - From Project Finance to Corporate Finance*, FPD Notes, The World Bank, October 1995.

4.2 **Strategies**

As discussed in Section 1.2.1, the current power infrastructure investment demand outstrips the supply of available foreign exchange. In such a scenario, four broad financing strategies can be listed:[3]

1. A reduction in investment levels in the power sector by improving efficiency
2. An increase in the amount of aid being spent in the power sector
3. An increase in private foreign investment in the power sector
4. An increase in domestic finance for power sector development

4.2.1 Reduction in Investment Levels

There are two ways to approach this: First, the demand for electricity can be reduced. Second, the use of electricity use can be restricted to those that can pay for it. The first aspect essentially deals with measures to increase the supply-side and demand-side efficiencies.[4] There is little debate regarding the possibilities of increasing these efficiencies. The problem, however, lies with the process of achieving and sustaining efficiency gains in practice especially when the efficiency trend is currently worsening in many developing countries.[5] Most policy options include increasing the flow of finance for both capital and recurrent expenditure and in increasing local managerial and technical capacities. But the increased supply of such resources is frequently constrained by the macroeconomic and political situation facing both utilities and governments.

Where resources are available for improvement it is often found that a cut in electricity needs is likely to be constrained on the supply side rather than the demand side (though this may be due in part to low electricity prices).[6] More efficient power supply would, therefore, increase the amount of electricity sold rather than necessarily postpone the need for new power capacity.

---

[3] Barnett, Andrew, *The financing of electric power projects in developing countries*, Energy Policy, April 1992.
[4] Bell, Martin, *Continuing industrialization climate change and international technology transfer, A report prepared in collaboration with the Resource Policy Group*, Norway, Science Policy Research Unit, Sussex University, UK, 1990.
[5] *Op cit*, footnote 3, Barnett, 1992.

The second option is grounded on the premise that electricity should be supplied only to those consumers that can afford to pay its full cost.[7] Accordingly, electricity for domestic consumption is a luxury good that should neither attract aid funds nor subscribe to subsidies for equity reasons. For private foreign investors, the flow of funds is largely determined by the perception of whether they can get their money back from investments in the power sector, and this is decided more by the creditworthiness of the economy than the viability of particular projects.[8] Studies indicate that indebtedness in developing countries has already lead to a decline in power investment.[9] This fall in investment can be a major constraint to achieving economic growth in the modern sectors of developing countries.

4.2.2 Increase in Aid

As evidenced in Section 1.2.1 any increase in aid to the power sector appears unlikely in the near future. The downward trend in aid allocations appears to have ceased for the moment; however, there seems little evidence that the international community is willing or even capable of substantially increasing aid allocation.[10] Moreover, interest rates at historically unprecedented levels and a hardening of import restriction to Northern markets, for example, through the common tariffs surrounding the single European Market are likely to continue.[11] The pressure within the donor society to shift the balance of funding towards direct support of poor people and to rural development will further reduce the amounts of aid available for power projects.

Against this background of unchanging aid volume, there is a possibility that the current terms and conditions of aid flows may change. Tying aid to goods and services

---

[6] *Ibid.*

[7] *Ibid.*

[8] Lamb, Christina, *Power surge on the Parana river*, Financial Times, May 7, 1991.

[9] Oliveira, A. De, *The key issues facing the electricity systems of developing countries*, The synthesis report of the cooperative program on energy and development, DG XVII, Commission of the European Communities, Brussels, 1991.

[10] *Op cit*, footnote 3, Barnett 1992.

[11] *Ibid.*

supplied by the donor country's industry is one such example.[12] The trend, however, is to move away from tied aid.[13] While this may result in lower costs of power equipment to developing countries, such untying might equally reduce the amount of aid developed countries are willing to provide.

Restructuring of electric utilities and price liberalization have also become integral to multilateral aid conditionality—mediated by lending agencies like the World Bank. This usually requires tariff formulation based on cost recovery, improved corporate governance, and some target for self-financing.[14] Some of these conditionalities aim to reduce the 'interference' and wider economic and developmental objectives of governments; however, they also tend to assume that the problems of the utility can be isolated from more widespread problems of the economy. [See Sections 1.2.7 and 1.3]

Another issue of potential controversy is subsidizing effect of aid—in the form of grants—on capital expenditure.[15] Where the aid is initially in the form of a grant, it is regarded by many donors to be good practice for the funds to be on-lent to the electric utility on commercial terms in local currency. However, where this is not done, their funds are clearly more attractive to the utility as being at best a grant and at worst additions to their equity on which they pay little or no dividend.[16] As a result, this can make funds for new capital equipment far cheaper than funds to meet recurrent expenditures. This subsidizing effect, in turn, leads to deferred maintenance expenditures, higher future operating costs, and higher system losses.

4.2.3 Increase in Private Investment through Limited Recourse Project Financing

The third option of attracting a larger volume of private investment to the power sector appears to offer some hope for meeting at least a portion of growing power needs.

---

[12] *Ibid.*

[13] There is considerable variation in the tied component for various donor agencies: well over half (65%) of the Japanese ODA is untied while less than 8% of Italian aid is, *Ibid.*

[14] Munasinghe, Mohan, Gilling, J., Mason, Melody, *A review of World Bank lending for electric power*, Working Paper Series Number 107, Industry and Energy Department, World Bank, Washington, DC, 1989.

[15] *Op Cit*, footnote 3, Barnett, 1992.

[16] *Ibid.*

One reason for this optimism lies in the fact that developing countries are major customers of power equipment manufacturers in the North.[17] These suppliers recognize that without additional investment from private sources their sales will not be forthcoming.

Many of the proposed schemes required to attract foreign capital derive from limited recourse project financing or concession financing schemes.[18] In developing-country markets the characteristics of these schemes match with the desire of many developing countries to obtain longer term commitments from contractors by imposing equity requirements and technical and operating support on potential projects.[19]

The most common form of non-recourse finance are Build Operate and Transfer (BOT) schemes where the contractors have the responsibility to build and operate a facility efficiently and in return they get the rights to sell the produce and rights to a proportion of revenues for a fixed period after which the facility reverts to the project sponsor.[20]

Despite apparent successes,[21] project financing in power infrastructure has delivered only a fraction of what was anticipated.[22] One major reason for this disappointing performance is the high-risk nature of power projects that make debt-providers increasingly wary about the current capital asset structure of project financing. The typical debt-equity ratio of today's project finance market is 70:30 in developing

---

[17] *Ibid.*

[18] In project financing or structured financing, the lender looks to the project's cash flows to repay the debt, and to the project's assets for security. Project sponsors seek project finance because it means the project can be funded off their balance sheet. Self-standing projects, with no guarantees given by the sponsors to lenders for the project, are known as non-recourse. In practice, most projects have limited recourse financing, where sponsors commit to provide contingent financial support, above their up-front equity commitment, to give lenders extra comfort. See Bond, Gary and Carter, Laurence, *Financing energy projects: Emerging trends from IFC's experience,* IFC, Discussion Paper No. 23, 1994.

[19] *Euromoney*, April 1989.

[20] *Op Cit*, footnote 3, Barnett, 1992.

[21] An example of a non-recourse project in the power sector is Citicorp putting together $200 million for a gas-fired co-generation project in Hopewell, Virginia.

countries and 80:20 in more-developed markets.[23] When developers are coming to debt providers—particularly banks—with the intention of minimizing their own company risks, the lenders hesitate to commit to an asset that could prove to be difficult to liquidate in the event of failure, particularly in developing countries. Debt providers typically do not share in the potential upside gains with the current debt-equity ratio and they stand to lose considerably in the event of default or bankruptcy.[24] This perception of potential risk gets translated into high transaction costs.[25]

Project developers, in effect, will have to restructure the present debt-equity ratio to the extent that equity levels are raised from 20-30% to at least 50%.[26] The corollary of this conclusion is that larger developers will displace smaller ones on the basis of their financial strengths to provide larger equities. With fewer larger players, the use of limited-recourse financing with its long lead times and high costs is likely to be an uncompetitive strategy. Except in cases where the "country risks" are considerably high and project financing offers the only alternative, successful bidders of power projects will be those willing to put their balance sheets at risk in order to reach financial closure.[27] Balance-sheet financing, or corporate financing, is the last option in our list of financing strategies that we take up next.[28]

4.2.4 Increase in Private Investment through Corporate Financing

In traditional corporate financing, lenders rely on the overall creditworthiness of the enterprise financing a new project to provide them security. If the enterprise is

---

[22] Between 1993 and 1995, only 10% of the over 600 letters of intent or MOUs between developers and governments for over 300,000 MW reaches financial closure. Data from RCG/Hagler Bailly Inc., Arlington, Virginia.
[23] Churchill, Anthony A., *Beyond project finance*, The Electricity Journal, June, 1995.
[24] *Ibid.*
[25] Author Anthony Churchill predicts the costs for preparing a typical limited-recourse financing are between \$4 million and \$8 million, and could go as high as \$30 million in larger projects. *Ibid.*
[26] The normal debt-equity ratio of the electric power sector in the much less risky US market is 50:50.*Ibid.*
[27] *Ibid.* See Section 4.2.4 on UK's example of corporate finance.
[28] In corporate financing, lenders look to the cash flow and assets of the whole company to service the debt and provide security. Op Cit, footnote 19, IFC, 1994.

publicly held, information on its performance and viability is usually available through stock markets, rating agencies, and other market-making institutions. This combination of security, liquidity, and information availability allows debt to be issued at a lower cost than through project finance.[29] Moreover, diversification of an enterprise's overall risk also lowers the cost of equity. This lowering of costs of debt and equity, in effect, lowers the cost of capital in corporate finance. When the lenders perceive lower risks, corporate finance should also have considerably lower transaction costs. Systematic empirical evidence specific to the power sector in the developing world is lacking, but anecdotal evidence suggests that corporate finance is indeed cheaper than project finance.[30] For example, the IPP experience in the United States indicates that the project-financed independent generation model may not necessarily be the most efficient mode for capital formation in generation.[31] While it has been shown that the cost of capital for a purchasing U.S. utility may be higher if it chooses to build its own generation capacity rather than purchase power from an IPP, much of this advantage is due to the adversarial regulatory environment in the United States, which favors IPPs.[32] Purchasing electricity from an IPP, therefore, appears to be less risky as all costs can be passed through or expensed through this arrangement.

Against this background, there is growing evidence that balance-sheet support is increasing in private power production. At a time when developing country governments are being advised by donor agencies to allow for competitive bidding in awarding power projects, successful bidders will be the ones who are able to find financing at the lowest

[29] Jechoutek, Karl G and Lamech, Ranjit, *Private power financing—From project finance to corporate finance*, Private Sector Notes No. 56, The World Bank, October, 1995.
[30] *Ibid.*
[31] The United States pioneered generation by independent operators on a merchant basis, and it is where the now ubiquitous term independent power producer, or IPP, originated. Project-financed independent generators have thrived in the United States, contributing more than half the additions to generation capacity in recent years. See Kahn, Steward, Stoft, Steven, and Belden, Timothy *Impact of Power Purchased from Non-Utilities on the Utility Cost of Capital*, Utilities Policy 5(1): 3-11, 1995.
[32] In the 1970s and 1980s, many utilities and their bondholders were hurt when regulators disallowed cost recovery for large investments in capacity. *Op Cit*, footnote 30, Jechoutek et al., 1995.

cost. In the competitive international IPP market, three specific trends indicate that balance sheet support is the preferred means for achieving this cost-of-capital advantage:[33]

The first indicator is that of project developers raising capital using their parents' balance sheets. Project developers are putting their own balance sheets at risk—or those of their parent companies—to raise cheaper debt for projects and to finance their equity contribution. For example, California Energy pioneered the largest corporate financing in the independent power business, raising US$530 million through ten-year securitized bonds in March 1994. Other examples include the Puerto Quetzal project in Guatemala (Enron), the Puerto Plata project in the Dominican Republic (Enron), and the Upper Mahaiao and Mahanagdong projects in the Philippines (California Energy). Chinese IPP developers, such as Huaneng Power and Xinli have also used their own balance sheets to raise finance.[34]

The second trend is that of project developers creating consolidated balance sheets. Developers are pooling projects into entities that are then able to raise capital on the strength of a combined balance sheet comprising the "pooled" assets of the different projects. Providers of equity and debt then finance the business of building and operating private generation facilities rather than an individual power plant. Pooling not only spreads project risk, but for multinational developers, it also reduces country-specific risk. IPP sponsors that have used this approach include Consolidated Electric Power Asia (CEPA), the San Francisco-based Bicoastal Energy Investors Fund (EIF), and Huaneng Power International (HPI) of China. [35]

---

[33] *Ibid.*

[34] *Ibid.*

[35] CEPA raised debt and equity in the capital markets on the basis of its corporate strategy of building multiple power plants in Asia. EIF securitized its equity interests in sixteen independent power projects in the United States, creating a synthetic balance sheet and issuing US$125 million of seventeen-year bonds. And HPI, which owns 2,900 megawatts of capacity under commercial operation and has another 5,900 megawatts under construction, raised US$332 million by listing its IPP business on the New York Stock Exchange in October 1994. *Ibid.*

The final trend is the increasing industry consolidation through mergers and acquisitions in the IPP business. Examples of some notable transactions among international players include the purchase of CMS Generation by HYDRA-CO Enterprises, the purchase of Magma Energy by California Energy Inc. and the acquisition of J. Makowski Co. Ltd. by PG&E Enterprises and Bechtel Enterprises to form International Generating Co. Ltd.[36] It has been argued that the increasing size and scope of projects is the main factor driving this change. Smaller companies are at an important disadvantage in international capital markets compared with larger players, with the latter's greater experience, capitalization, and track records [See Section 4.2.3]. Although these mergers and acquisitions could be driven by a number of strategic objectives, increased balance sheet support in project development is clearly one of them.[37]

Apart from the evidence of increasing balance-sheet support for IPPs, this kind of financing is likely to become the default alternative in a restructured power-sector.

Traditional project finance is based on allocating demand risk to the purchaser, whether an integrated utility, a central generator and purchaser, a distribution utility, or a large consumer.[38] This risk allocation works well because purchasers have a monopoly franchise area, which they are obliged to serve. Against a retail competition scenario, however, purchasing utilities will face increased demand risk as the loss of customers becomes a greater possibility. Innovative sharing of demand risk between market players—the power seller, the power purchaser, and the financier—will, therefore, become necessary.[39] An IPP developer's ability to bear any of the demand risk will depend in part on its willingness to provide corporate assets and revenues as a fallback for lenders. For example, the most recent additions to generation capacity in the United Kingdom—the model of sector unbundling—have been corporate-financed IPPs.[40]

Similarly, industry players in the United States are creating highly capitalized enterprises as competition for retail consumers looms on the horizon. The recently

---

[36] *Ibid.*
[37] *Ibid.*
[38] *Ibid.*
[39] *Ibid.*
[40] *Ibid.*

announced US$1.26 billion merger of Public Service Co. of Colorado and Southwestern Public Service Co. is a reaction to the perceived increase in demand risk stemming from plans for wider retail competition.[41]

All said and done, greater corporate finance support has paved way for wider, deeper, and cheaper sources for raising private capital for independent power generation. Our next quest is to find what role capital markets play in sustaining balance-sheet financing.

4.2.4.1 The Role of Capital Markets

Capital markets are financial markets where private investors turn to for their debt and equity requirements. The amount of debt or equity granted to an established enterprise is based on the strength of its balance sheet. An increase in size and activity of a capital market, by extension, should reflect the status of corporate financing involved. Going by the argument that project financing will eventually have to give way to corporate financing, development of domestic capital markets is a must to accommodate massive infrastructure investments in developing countries. After having raised capital to build the infrastructure, developers, international and local alike, would want an exit strategy that allows them to realize their capital gains by selling their equity and parking the debt elsewhere.[42] Local capital markets are in the best position to absorb these assets.

4.2.4.2 Trends in Domestic Capital Markets

Following from the previous discussion, growth trends of capital markets in countries where private infrastructure investments are taking place would be a reliable indicator of increasing corporate finance. The search for existence of such trends will be the aim of this section.

---

[41] *Ibid.*

[42] Churchill, Anthony, *Beyond Project Finance*, p.24, Electricity Journal, June 1995.

We begin this analysis by defining capital market development measures that were used by Ross Levine and Asli Demirguc-Kunt (May 1995) in a statistical report published by the World Bank.[43]

A. Stock Market Development Indicators

(i) *Stock Market Size*

The market capitalization ratio equals the value of listed shares divided by GDP and analysts frequently use the ratio as a measure of stock market size. In the rest of this discussion, we refer to this measure as "market capitalization". In terms of economic significance, the assumption behind market capitalization is that market size is positively correlated with the ability to mobilize capital and diversify risk.

(ii) *Liquidity*

In simple terms, liquidity refers to the ability to easily buy and sell securities. A comprehensive measure of liquidity would quantify all the costs associated with trading, including the time costs and uncertainty of finding a counterpart and settling the trade. Since data is very limited for a cross-country comparison of liquidity, Levine et al. have used two measures of realized stock trading.

The first measure is the total value traded / GDP equals value of total shares exchange divided by GDP. This ratio measures the organized trading of equities as a share of national output and therefore should positively reflect liquidity on an economy-wide basis. The total value traded / GDP ratio complements the market capitalization ratio. Although market capitalization may be large, there may be little trading.

A second measure of liquidity is the turnover ratio. Turnover equals the value of total shares traded divided by market capitalization. High turnover is often used as an indicator of low transaction costs. The turnover ratio also complements market capitalization. A small but active market will have small market capitalization but above average turnover. Turnover also complements total value traded / GDP. While total value traded / GDP captures trading compared with the size of the economy, turnover measures

[43] The definitions and methodology used for this analysis are borrowed *from Stock Market Development and Financial Intermediaries*, a World Bank's Policy Research Working Paper by Asli Demirguc-Kunt and Ross Levine, May 1995.

trading relative to the size of the stock market. Put differently, a small, liquid market will have a high turnover ratio but a small total value traded / GDP ratio.

(iii) *Volatility*

This indicator is a twelve-month rolling standard deviation estimate based on market returns. Although greater volatility is not necessarily a sign of more or less stock market development, "less volatility" is sometimes referred to as reflecting "greater stock market development" for simplicity.

(iv) *Concentration*

In some countries a few companies dominate the market. To measure the degree of market concentration, the share of market capitalization accounted for is computed by the ten largest stocks and call this measure as concentration.

(v) *Asset Pricing*

Analysts generally refer to countries that are more integrated into world capital markets and price risk more efficiently as "more developed." Asset pricing is a measure of the degree of integration between national stock markets and gauging whether markets price risk efficiently. To measure asset pricing efficiency, the Levine et al. use estimates of asset mis-pricing computed by Robert Korajczyk.[44] As argued by Korajczyk and Viallet, the capital asset pricing model and arbitrage model imply that the expected return on each asset is linearly related to a benchmark portfolios. In domestic versions of these asset pricing models, the benchmark portfolios include only securities traded on the local exchange, while the international versions include all securities. If the models are correct, then the benchmark portfolio or combination of portfolios should explain all of the systematic expected returns on assets above the risk-free interest rate. Levine et al. term systematic deviations of expected returns as "risk mis-pricing" under the maintained hypothesis that the model is correct.

The APT and ICAPM are the indices computed using an international arbitrage pricing model and international capital asset pricing model, respectively. Korajczyk (1994) computes the degree of risk mis-pricing between domestic stocks and the prices of

[44] Northwestern University, *Measuring Integration of Developed and Emerging Stock Markets*, mimeo.

risk in world capital markets using these two models. These risk mis-pricing indicators measure capital market integration; with no arbitrage, the price of risk should be equalized across national borders. Greater mis-pricing may reflect poor information about firms, high transaction costs, and official barriers to international asset trading. For the purpose of this analysis, the authors refer to greater mis-pricing as indicating less stock market development.

(vi) *Regulatory and Institutional Indicators*

Regulatory and institutional factors may influence the functioning of stock markets. For example, mandatory disclosure of reliable information about firms and financial intermediaries may enhance investor participation in equity markets. Regulations that instill investor confidence in brokers and other capital market intermediaries should encourage investment through and trading in the stock market.

To measure regulatory and institutional features of emerging stock markets, Levine et al. use seven indicators constructed by the International Finance Corporation (IFC). The first indicator shows whether the firms listed in a stock market publish price-earnings information. The IFC gives a value of 0 or 1, where 1 indicates the information is comprehensive and published annually. The second indicator measures accounting standards. The IFC assigns 0, 1, or 2 for countries with poor, adequate, or good (internationally accepted) accounting standards. The third indicator measures the quality of investor protection laws as judged by the IFC where 0,1, or 2 are used to indicate poor, adequate, or good investor protection laws. The fourth indicator shows whether the country has securities and exchange commission or not. The fifth, sixth, and seventh indicator measure restrictions on dividend repatriation by foreign investors, capital repatriation by foreign investor, and domestic investments by foreigners. The IFC assigns values of 0,1 and 2, indicating whether capital flows are restricted, have some restrictions, or are free, respectively. The institutional development indicator aggregates these seven regulatory-institutional indicators by simply averaging them.

A.1. Correlation among stock market development indicators:

Table 4a provides the correlations among the many stock market development indicators found by Levine et al. for up to 41 observations between 1986 and 1993.[45] From this table, four points can be made: First, market capitalization is strongly positively correlated with total value traded / GDP and institutional development and negatively correlated with risk mis-pricing, volatility and market concentration. This implies that countries with big stock markets are more efficient, less volatile, and less concentrated. Furthermore, market capitalization has no strong correlation with turnover. This suggests that a large market size does not necessarily increase or decrease the extent of trading.

Second, while both measures of liquidity are strongly positively correlated to each other, they do not move one for one. A highly liquid market also indicates a well developed institution. Market concentration and volatility are strongly negatively correlated with both indicators of liquidity. Risk mis-pricing, however, is strongly negatively correlated with trading compared with the size of the economy while it is insignificantly correlated with trading relative to the size of the stock market. This suggests that liquidity with respect to the size of the national economy is more indicative of risk pricing than that with respect to the size of the size of the domestic stock market. Third, countries that are more internationally integrated—as measured by low APT and ICAPM values—have less volatile stock returns and less market concentration. Interestingly, institutional development had no significant correlation with risk mis-pricing.

Fourth, volatility and market concentration have no significant correlation with each other. Moreover, a highly volatile or concentrated stock market is apparently not a reliable indicator of the extent of a country's institutional development. A.2. Overall Stock Market Development Index:

Although many of the above stock market development indicators are significantly correlated in intuitively attractive ways, the correlation coefficients are

[45] The actual numerical relationships of various indicators in the original paper have been replaced by symbols for simplicity. *Op cit*, footnote 43, Levine et al.

Table 4 a: Correlation of Stock Market Indicators, 1986-1993

	Market Capitalization	Total Value Traded/GDP	Turnover	APT Mis-Pricing	ICAPM Mis-Pricing	Volatility	Market Concentration	Institutional Development
Market Capitalization	*	+	↔	-	-	-	-	+
Total Value Traded/GDP		*	+	-	-	↔	-	+
Turnover			*	↔	↔	↔	-	+
APT Mis-Pricing				*	+	+	+	↔
ICAPM Mis-Pricing					*	+	+	↔
Volatility						*	↔	↔
Market Concentration							*	↔
Institutional Development								*

Note:
'+' indicates strong positive correlation; '-' indicates strong negative correlation; '↔' indicates insignificance of any correlation

Source: Levine et al. (1995)

frequently below 0.6. The correlations suggest that the different indicators capture different aspects of stock market development. To measure how well stock markets function in general, i.e., to compute an index of overall stock market development, Levine et al. came up with the SMDI INDEX 1 which aggregates information on market capitalization, total value traded / GDP, and turnover. The authors have also devised other indices that capture other indicators but since market capitalization and liquidity together are standard measures of a country's stock market development, we restrict our analysis to the SMDI INDEX 1.

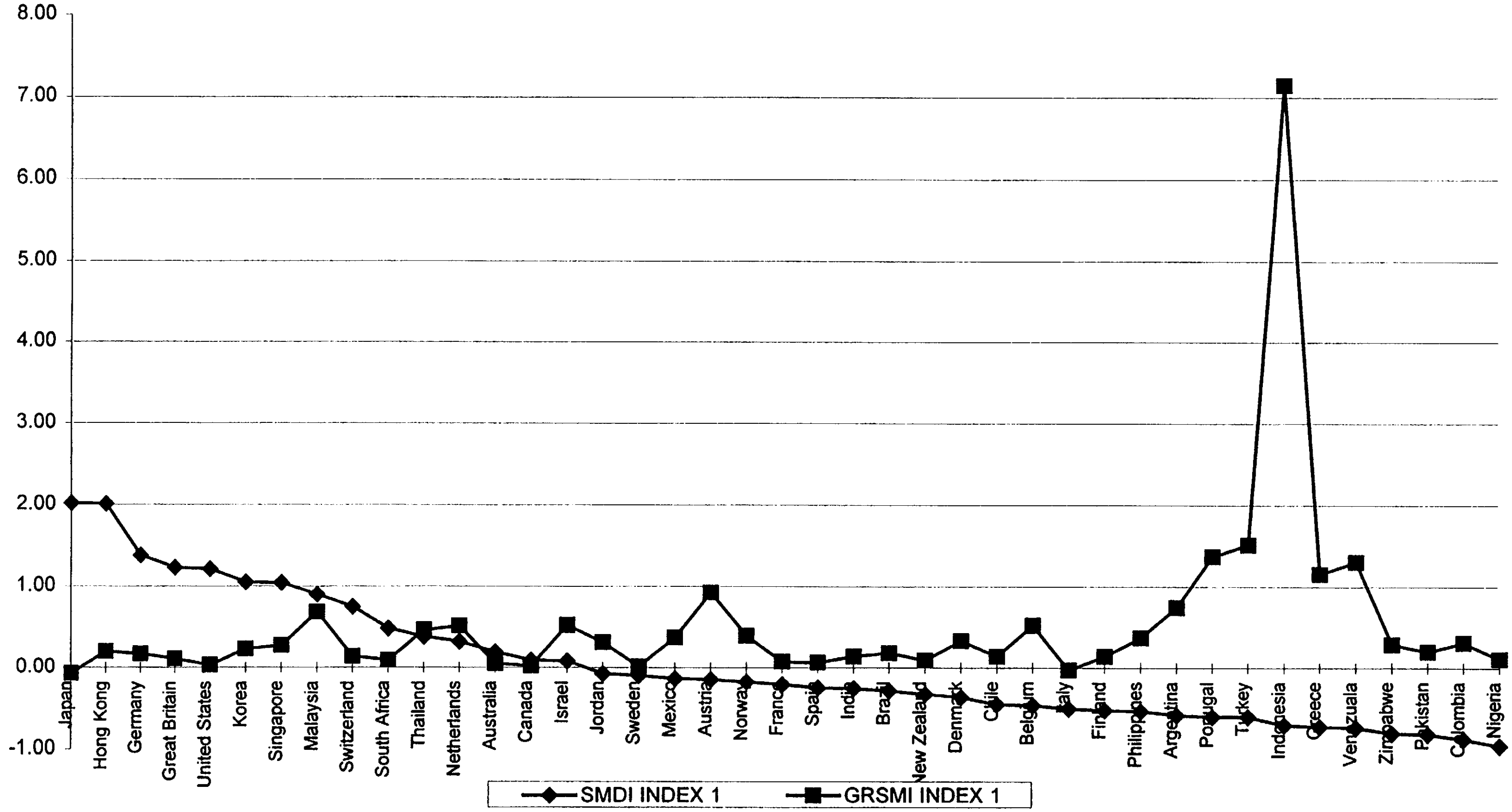
The computation of the SMDI INDEX 1 follows a two-step procedure. First, for each country 'i' compute the means-removed market capitalization, total value / GDP, and turnover ratios. The means-removed value of variable X for country 'i' is defined as $X(i)^m = [X(i) - \text{mean }(X)] / [\text{ABS}(\text{mean }(X))]$ where ABS (z) refers to the absolute value of 'z'. For mean (X), we use the average value of X across all countries over the 1976-93 period.

A.3. Rates of Growth of stock markets:

In the last section, we ranked countries according to their average levels of stock market development over the 1986-93 period. In the context of the query this thesis attempts to address, we are interested in finding out the most rapidly developing stock markets to find out any relationship that exists between stock market growth and private sector investment in power infrastructure. As in the previous section, the average annual growths of market capitalization, total value traded / GDP, and turnover ratios are used to find the overall growth rate of stock market index GRSMI INDEX 1. Figure 4a shows that Indonesia, Turkey, Portugal, Venezuela, and Greece have the most rapidly growing stock markets while Japan, Italy, Sweden, Canada, and United States have the least growing stock markets.

While we will come back to this table later to look at specific country performances in relation with power infrastructure investments by the private sector, some general observations can be made at this point. For simplicity, we divide the 41 countries into three groups. For the SMDI INDEX 1, those countries with greater than +0.5 deviation

Figure 4. 1: Initial Stock Market Development and its Growth Rate



Note: The SMDI INDEX 1 is an aggregate indicator of initial stock market development The GRSMI INDEX 1 indicates the rate of growth of a stock market from the mean would be assumed to have HIGH stock market development. Those with lower than -0.5 deviation from the mean would be assumed to have LOW stock market development. The countries that fall within these boundaries would be thought to have MEDIUM stock market development. Similarly, for the GRSMI INDEX 1, those countries with lower than +0.2 deviation from the mean would be assumed to have LOW growth rates; those with higher than +0.5 deviation from the mean would be thought to have HIGH growth rates; and the balance would fall under the MEDIUM growth rate category. We observe that 6 out of the 10 LOW stock market development category countries have HIGH stock market growth rates.

B. Financial Intermediary Development:

Well established capital markets require that well developed stock markets be complemented by matured banks and nonbank financial intermediaries. To verify this statement, we need to find measures of financial intermediary development. Levine et al. have come with four measures.

(i) Financial System Development

Based on work by King and Levine (1993), Levine et al. use three measures of financial system development. The measure M3 /GDP equals liquid liabilities of the financial intermediaries divided by GDP. It is a measure of the overall size of the formal financial system. The second measure, QLLY, equals (M3-M1) / GDP where M1 / GDP represents highly liquid bank deposits. The QLLY indicator thus measures quasi-liquid liabilities. Analysts sometimes use QLLY instead of M3 / GDP because the latter may not be as closely associated with efficient financial intermediation as longer-term investments in financial intermediaries. In contrast, QLLY focuses on measuring longer-term or quasi-liquid liabilities, i.e., M3 - M1. Since liquid and quasi-liquid liabilities that finance government deficits may not reflect the provision of efficient financial intermediary services (such as acquiring information about firms, monitoring managers, and facilitating transactions and risk diversification), the authors compute the variable PRIV / GDP, which is, the ratio of domestic credit to private firms divided by GDP.[45]

(ii) *Bank Development*

To measure the level of development of the banking system, Levine et al. use BY / GDP, which equals the ratio of the total claims of deposit in banks to GDP.

(iii) *Nonbank Development*

The size of non-bank financial corporations, such as finance companies, mutual funds, brokerage houses and so on is measured by PNB / GDP which equals private nonbank financial intermediary assets divided by GDP.

(iv) *Insurance and Pension Companies*

Finally, the size of private insurance and pension companies is measured by INPE / GDP which equals private insurance company and pension fund assets divided by GDP.

B.1. Correlations among Financial Intermediary Indicators

Levine et al. show that the measures of financial system size, M3 / GDP, QLLY, and PRIV / GDP are very highly correlated and significant. The correlations between the financial system size indicators and indicators of the size of banks, private nonbanks, and private insurance and pension companies, however, are not as strong. While all of the correlations are positive, many are not significant. For example, while countries with big financial systems have big banks and nonbank financial corporations, the correlation between financial system size and private insurance and pension companies is not strong.

B.2. Overall Financial Intermediary Development Index:

Similar to the methodology used in finding out the overall stock market development index, an aggregate index for measuring the overall financial intermediary development is computed. The FINDEX 3 combines the means-removed values of BY / GDP, PNB / GDP, and INPE / GDP over the 1986-93 period. In other words, FINDEX 3 combines the information on the size of banking system, the size of private nonbank

[45] Unfortunately, while the International Financial Statistics classifies credit as "claims on the private sector,"some of these claims in some countries include credit to public enterprises.

financial corporations, and the size of private. The authors have also come up with other indices, too, but they prefer FINDEX 3 to the rest since they point out that others mix information on particular intermediaries with information on intermediary liabilities and the measures of liabilities span across different types of intermediaries.

We repeat the categorization of 40 observations for FINDEX 3 by grouping countries into HIGH, MEDIUM, and LOW financial intermediary developments. Those countries with greater than +0.5 deviation from the mean would be assumed to have HIGH financial intermediary development. Those with lower than -0.5 deviation from the mean would be assumed to have LOW financial intermediary development. The countries that fall within these boundaries would be thought to have MEDIUM financial intermediary development.

From Figure 4b, it appears that there is a strong positive correlation between financial intermediary development and stock market development. Excluding two countries, namely, South Africa and Thailand, all other countries with below-mean FINDEX 3 values have below-mean SMDI INDEX 1 values.

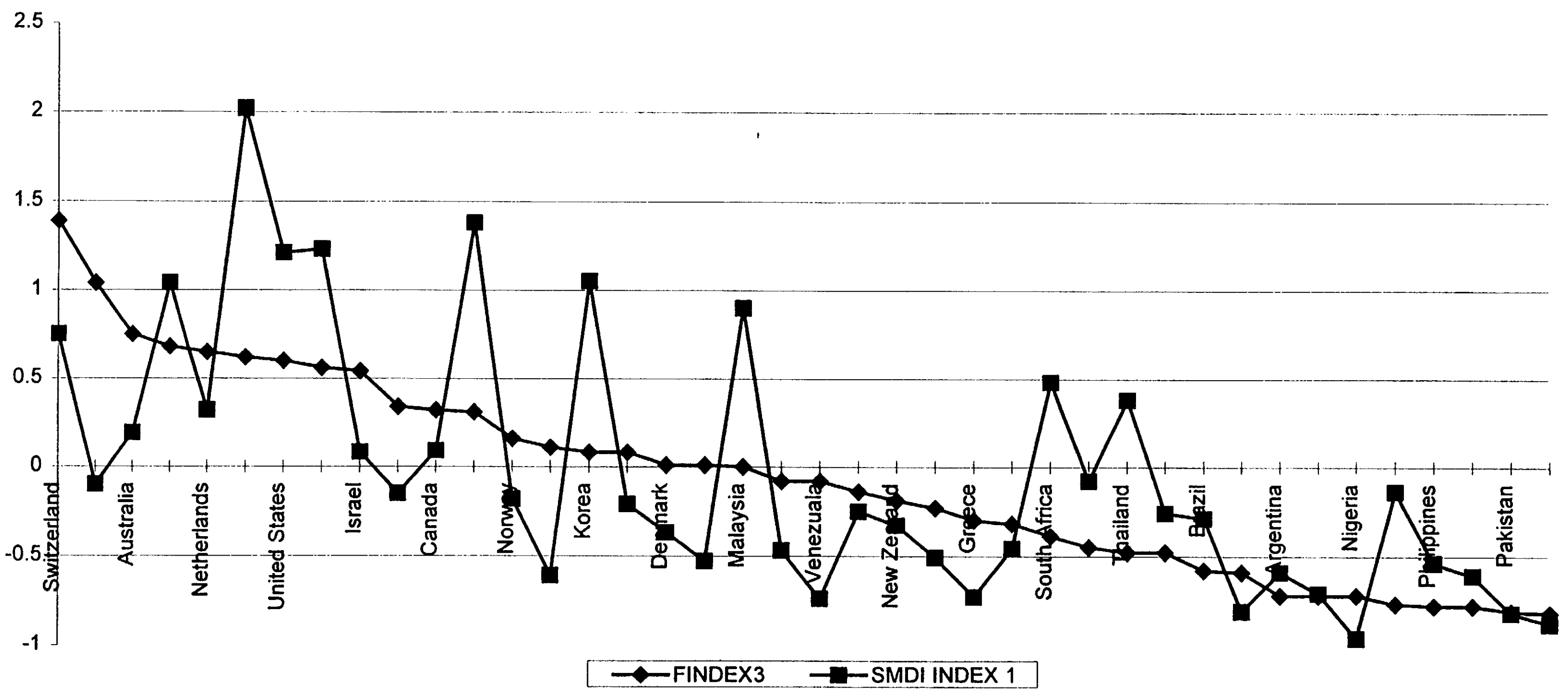
From the discussion so far, we have empirical evidence that point to two important results: First, countries which initially had relatively less developed stock markets have the highest stock market growth rates in the period during 1986-1993. These countries include Mexico, Chile, Philippines, Argentina, and Turkey among others. Second, countries with relatively well-developed stock markets generally possessed well-established financial intermediaries.

If combined the above results strongly suggest that rapidly growing stock markets will need to be complemented by financial intermediary development at a positive rate, if not at the same rate, for overall capital market development.

C. Domestic Capital Market Growth and Private Infrastructure Investment

We began this chapter with the objective of finding a correlation, if any, between domestic capital market growth and private power-sector investments. We had so far focused on domestic capital market growth for several countries. We now narrow down to six countries that have not only either partially or fully privatized their infrastructures

Figure 4. 2: Stock Market and Financial Intermediary Development



Note: The SMDI INDEX 1 is an aggregate indicator of initial stock market development. FINDEX 3 is an aggregate indicator of financial intermediary development.

for providing electricity between 1989 and 1992 but have also power infrastructure stocks traded in their respective stock markets. These countries are Argentina, Brazil, Chile, Malaysia, Philippines, and South Korea. A summary of various categories (HIGH, MEDIUM, and LOW) for these countries falling under the three indices, i.e., SMDI INDEX 1, GRSMI INDEX 1, and FINDEX 3 is shown in Table 4b. Some observations of significance can be made at this point. First, financial intermediary development appears to follow stock market development. For example, Brazil, Malaysia, South Korea, and have stock markets that are relatively better developed than their financial intermediaries. The rest of the countries have equivalent levels of financial intermediary development and stock market development.

Second, Argentina and Malaysia have the most rapidly growing stock markets. While it appears reasonable that Argentina with a LOW initial stock market development should be expanding the most, Malaysia stands out as a notable exception with its HIGH stock market development already in place and still growing at a fast pace. Since we do not have an index analogous to the GRSMI INDEX 1 that reflects the growth rate of financial intermediary development, we borrow one of conclusions earlier made to reach a reasonable approximation. That there is a significant positive correlation between stock market development and financial intermediary development, we can expect that rapidly growing stock markets would lead to a less rapid, if not equally rapid, growth of financial intermediaries.

We now examine the growth trends of electricity stock market capitalization, net foreign direct investment (FDI), and bonds/loans raised in international capital markets and their effects on total stock market capitalization for the six countries at different stages of capital markets growth.[46]

---

[46] Total stock market capitalization data have been obtained from *Lessons of Experience: Financing Private Infrastructure*, IFC, The World Bank, DC, 1996. Electricity/Gas utility market capitalization data, obtained from IFC's *Factbook: Emerging Markets Data Base,* have been available since 1993. For the purpose of our analysis, we have used IFC Global (IFCG) indexes—intended to represent the performance of the most active stocks in their respective stock markets, and to be the broadest possible indicator of market movements—for the electricity/gas utility market capitalization.

Table 4 b: Stock Market and Financial Intermediary Development Indices, 1986-1993

Countries	SMDI INDEX 1	GRSMI INDEX 1	FINDEX 3
Argentina	L	H	L
Malaysia	H	H	M
Chile	M	L	M
South Korea	H	M	M
Philippines	L	M	L
Brazil	M	M	L

Argentina

From Table 4b, it can be inferred that Argentina's stock market development (SMDI INDEX 1) and its financial intermediary development (FINDEX 3) were still in their incipient stages and that they were growing at a rapid rate (GRSMI INDEX 1) till 1993. From 1994 onwards, stocks of electricity/gas/sanitary services were traded in Argentina's local stock exchange [See Table 4c]. Also worth noting is the relatively large amounts of foreign direct investment (FDI) and international bond issues pouring into Argentina since 1991. With no electricity stocks registered through 1993, it would be fair to say that Argentina's electricity privatization was largely aided by FDI and bonds raised in international capital markets.[47] As evidenced by the regression results in Table 4c, bonds/loans raised on international capital markets (X3) is a significant determinant of total stock market capitalization. While electricity/gas/sanitary service stock capitalization (X1) is positively correlated with total stock capitalization, the relationship still statistically insignificant. Also worth noting is the R^2 value; the three independent variables explain 98 per cent of the variation in total stock market capitalization.

[47] Both the country's electricity and gas services were divested in 1992. See OECD, *Privatization in Asia, Europe, and Latin America*, p.81,1996.
[47] Both the country's electricity and gas services were divested in 1992. See OECD, *Privatization in Asia, Europe, and Latin America*, p.81,1996.

Malaysia

In 1992, Malaysia carried out sales of equity (SE) of Tenega Nasional Berhad (National Electricity Corporation) as part of its infrastructure privatizations.[48] Since the date the company has been listed in the Kuala Lumpur Stock Exchange (KLSE), Tenega Nasional's market capitalization has gone up by 3.2 times the original issued value.[49] As shown in Table 4c, electricity/gas/sanitary stock capitalization (X1) is a positively correlated with total stock market capitalization. Net FDI appears to contribute negligibly to stock market capitalization, and bonds/loans raised in international capital markets is negatively correlated with total stock market capitalization. For a country whose stock market development is high [see Table 4b], these findings strongly support the thesis that private power-sector investments have further stimulated the growth of domestic capital markets. These findings also suggest that countries with well capitalized markets depend less on net FDI for equity and much less on international debt.

Chile

Chile falls in between Malaysia and Argentina in terms of capital markets development and growth [See Table 4b]. Its SMDI, FINDEX, and GRSMI indices all fall under the MEDIUM category. Chile, however, privatized its power utilities well before the other two countries. In 1987, shares worth US$500 million of Chile's largest power generating company, ENDESA, were offered in the local stock market. Before 1990, the three subsidiaries of CHILECTRA, another large state-owned power utility, were privatized. We do not have annual stock market capitalization data for the period prior to 1990, but from the utility stock data available from 1992 onwards [See Table 4c], we can still study the impacts of FDI and utility stocks on total stock market capitalization. Unlike in the cases of Argentina and Malaysia, net FDI (variable X2) is a positive and significant determinant of total stock market capitalization for Chile.[50] That net FDI plays

---

[48] OECD, *Privatization in Asia, Europe, and Latin America*, p.42,1996

[49] The increases in market capitalization for Tenega Nasional was noted in mid-March, 1994.

[50] The high positive significance of variable X2 and positive insignificance of X1 is attributed to the drastic decline in utility stock market capitalization between 1993 and 1994.

.

Table 4 c: Stock Market Capitalization, Electricity Stocks, and net FDI

(in millions of US dollars)

Argentina

Year	Y	X1	X2	X3
1991	18509	0	2439	725
1992	18633	0	4179	1529
1993	43967	0	6305	6473
1994	36864	125	1200	5716
1995	37783	1133	3900	3947

Regression Output

Constant	11868		
Std. Err. Of Y Est.	3258		
R Squared	0.98		
No. of Obs.	5		
Degrees of Freedom	1		
	X1	X2	X3
X Coefficients	5.95	0.63	4.22
Std. Err. Of Y Est.	3.31	0.87	0.67
T-Statistics	1.80	0.72	6.27*

*significant at 0.20 level

Malaysia

Year	Y	X1	X2	X3
1990	48611	0	2333	730
1991	58627	0	3999	512
1992	94004	5000	4469	1271
1993	220328	10189	5000	1612
1994	199276	16306	4300	3526
1995	222729	17384	5800	2397

Regression Output

Constant	71067		
Std. Err. Of Y Est.	40700		
R Squared	0.90		
No. of Obs.	6		
Degrees of Freedom	2		
	X1	X2	X3
X Coefficients	13.95	2.10	-31.80
Std. Err. Of Y Est.	11.67	34.92	61.40
T-Statistics	1.20	0.06	-0.52

Chile

Year	Y	X1	X2	X3
1990	13545	NA	590	285
1991	27984	NA	523	NA
1992	29644	5452*	699	350
1993	44622	21500	841	775
1994	68195	12003	1795	80
1995	72928	12110	2300	903

*Approx.

Regression Output

Constant	8955	
Std. Err. Of Y Est.	6092	
R Squared	0.97	
No. of Obs.	4	
Degrees of Freedom	1	
	X1	X2
X Coefficients	0.69	25.65
Std. Err. Of Y Est.	0.53	4.58
T-Statistics	1.29	5.59*

*significant at 0.20 level

NA = Not Available
Y = Total stock market capitalization
X1 = Electric/gas utility stocks
X2 = Net Foreign Direct Investment
X3 = Loans/bonds raised in international capital markets

a major role in expanding local stock markets especially when utility stock capitalization itself may be wavering may a plausible inference from the above analysis

South Korea

Like Malaysia, South Korea also has a highly developed stock market and financial intermediary [See Table 4b]. The growth rate of South Korea's stock market was, however, slower than that of Malaysia. South Korea carried out its privatization of its electric utility, the Korean Electric Power Company (KEPCO), in 1989 on a broad-based, popular capitalism mode of British Telecom. KEPCO offered 21 percent—equivalent to $1.9 billion worth of shares—of its total equity to the public.[51]

KEPCO is now far the largest company in terms of market capitalization on the Korean Stock Exchange. Analysis of South Korea's stock markets shows results similar to those of Malaysia with the exception that, in this case, electricity/gas stocks is a positive significant determinant of total market capitalization [See Table 4d]. The negative correlation between variable X3 and Y is stronger. The Malaysian and Korean examples demonstrate that infrastructure stocks is the largest contributing factor in deepening well capitalized markets.

Philippines

With respect to the levels of growth of stock markets and financial intermediaries, the Philippines share similar characteristics with Argentina [See Table 4b]. Lack of sufficient data for bonds/loans raised in international capital markets (variable X3) precludes us from examining the contribution of this variable to market capitalization. That apart, results of the regression analysis show that both electricity/gas stocks and net FDI are positive, but insignificant, determinants of market capitalization. These results match with those of Argentina. With low stock market and financial intermediary development, it is reasonable to conclude from the analyses of these two countries that all

[51] McLindon, Michael P., *Privatization and capital market development: Strategies to promote economic growth*, 1996.

Table 4 d: Stock Market Capitalization, Electricity Stocks, and net FDI

(in millions of US dollars)

S. Korea

Year	Y	X1	X2	X3
1990	110594	0	788	3982
1991	96373	0	1180	6437
1992	107448	0	727	5204
1993	139420	16486	588	5962
1994	191778	21242	809	6483
1995	181955	24762	17724	11087

Regression Output

Constant	12867		
Std. Err. of Y Est.	16485		
R Squared	0.934		
No. of Obs.	6		
Degrees of Freedom	2		
	X1	X2	X3
X Coefficients	4.59	49.33	-13
Std. Err. Of Y Est.	1.47	57.21	14
T-Statistics	3.11**	0.86	-0.93

**significant at 0.10 level

Philippines

Year	Y	X1	X2	X3
1990	5927	0	NA	715
1991	10197	0	544	NA
1992	13794	0	228	NA
1993	40327	3625	763	1250
1994	55519	3871	1000	1164
1995	58859	3231	NA	673

Regression Output

Constant	7780	
Std. Err. of Y Est.	8994	
R Squared	0.94	
No. of Obs.	4	
Degrees of Freedom	1	
	X1	X2
X Coefficients	8.30	10.47
Std. Err. Of Y Est.	5.13	33.80
T-Statistics	1.62	0.31

Brazil

Year	Y	X1	X2	X3
1990	16354	0	989	NA
1991	42759	0	1103	1480
1992	45261	0	2061	3010
1993	99430	12613	1292	6465
1994	189281	25632	3072	3998
1995	147636	23594	4859	7041

*Approx.

Regression Output

Constant	8955		
Std. Err. Of Y Est.	6092		
R Squared	0.97		
No. of Obs.	4		
Degrees of Freedom	1		
	X1	X2	X3
X Coefficients	6.12	-3.45	-5.40
Std. Err. Of Y Est.	0.75	5.38	3.22
T-Statistics	8.14*	-0.64	-1.70

*significant at 0.1 level

NA = Not Available;
Y = Total stock market capitalization
X1 = Electric/gas utility stocks
X2 = Net Foreign Direct Investment
X3 = Loans/bonds raised in international capital markets

Sources:
(1) Emerging Markets Data Base, IFC Factbook, 1994-96
(2) Lessons of Experience: Financing Private Infrastructure, IFC, 1996
(3) The Irwin Guide to Investing in Emerging Markets, 1995

the three variables, at different level of significance, positively contribute to total stock market capitalization.

Brazil

At first glance, the analysis of Brazil's capital market seems to be peripheral, if not irrelevant, to our discussion on private-sector financing. Unlike Argentina and Chile, Brazil did not decide to reform its power sector up and till 1995, when a law was passed to permit private concessions for electric power distribution and natural gas transport. Several Brazilian state governments have launched programs to sell state equity in electricity distribution, telecommunications, and banks.[52] While private concessionaires had been involved in generation (0.3%) and distribution (2.1%) prior to the new law, all policy and investment decisions have so far resided with the federal government.[53]

Brazil's capital market, however, allows us to carry out a "control" analysis, that is, we can examine the impacts of all the three variables (X1, X2, and X3) on market capitalization in the absence of any major private-sector investment but with electricity/gas stocks still listed in the local stock exchange.[54] The results are not surprising: Lack of private-sector participation in the infrastructure sector appears to have discouraged the net flow of FDI and issuance of bonds/loans in international capital markets [See Table 4d]. Electricity/Gas stocks, on the other hand, has a strong positive, significant correlation with total market capitalization. That Brazil's market capitalization growth is heavily dependent on its local infrastructure stocks, in the absence of FDI and lack of access to international capital, does not, however, bode well for future investment demands that would eventually require foreign capital.

In conclusion, we have examined six different developing country capital markets—each at a different level of growth and maturity—that have had electricity stocks being traded in their local stock exchanges. While the trading of electric utility stocks in developing countries is still a recent phenomenon, and consequently, data is too

---

[52] World Bank, *Trends in Developing Economies 1996*, Washington, DC, 1996.

[53] The numbers are taken from *Electrobras 1994: Plan 2015: National Electric energy plan 1993-2015*, Vol. I, Executive Report Summary.

[54] As of June 1992, stocks of Electrobras, Light, Cemig, and Cesp—all state-owned power companies—were trading in the SENN stock exchange.

scant to carry out a comprehensive time-series analysis, the cross-country studies do offer us some useful insights. First, growth of private power infrastructure investment is strongly correlated with that of the local stock (or capital) market. Second, depending on the existing level of capital market development growth, the significance of contributing variables (net FDI, international bonds/loans, and electricity stocks) will vary. A nascent and growing local capital market will require more of loans/bonds and FDI to expand itself. A matured capital market will seek more of its own resources to finance infrastructure investments. In effect, growth of variables on one side of equation fuels the growth of variables on the other side and vice versa.

4.3 **Summary**

Despite widely varying macroeconomic conditions and political constitutions, developing countries that have been actively pursuing private infrastructure investments have depended on international and domestic capital markets for their partial debt and equity requirements. Pension and insurance companies have been willing takers of equity in infrastructure companies where long-term investments and steady returns are typical. During the privatization process, different methods of divestiture are often employed. Public bids, initial public offerings in the stock market, direct sales to individuals or entities outside the stock market, management and employee buy-outs, are some of the common approaches. Ultimately though, as we pointed out in this chapter's introductory lines, there needs to be a clearinghouse where investors can readily exchange their debt and equity for cash and exit from the market. Greater corporate finance support through local and international capital markets makes it possible to raise private capital for independent power financing from wider, deeper, and cheaper sources.

5. POLICY RECOMMENDATIONS FOR INCREASED PRIVATE-SECTOR INVESTMENT

5.1 Revisiting Earlier Premises

Throughout our discussion, we have assumed that private-sector participation in electricity service provision of developing countries would lead to an improvement in operational efficiency and service quality. Under this scenario, we asserted that increased private capital—domestic and international alike—is likely to flow into what is usually a supply-deficit power sector.

From our multiplicity-ownership analysis, we saw that while multiplicity creation through unbundling of electricity services alone could result in performance improvement in efficiency and service quality, the overarching requirements for investment capital and laissez-faire in energy infrastructure provision makes private-sector involvement a prior necessity. In other words, divestiture of state-owned assets accompanied by unbundling of services should be a means to competitive ends. Competitive ends, in turn, is a means to the desired end of increased economic efficiency.

The question is whether operational efficiency and private capital are always the undisputed policy goals of private-sector participation in the power sector. It may be the case that a government would simply want to sell off its utility for the highest price without any genuine concern for its long-term consequence on service reliability and tariff charges. Under this assumption, it may be in the government's best interest not to restructure the utility to introduce competition; otherwise, investors could bid less when they anticipate competition or effective regulation.[1]

In contrast, an equity-driven policy goal may be to create a widespread share ownership by offering utility shares to individual investors and to employees. This way, the government does not maximize the proceeds of the sale, but hopes that the country's

---

[1] Hyman, Leonard S., *The Privatization of Public Utilities*, Public Utilities Reports, Inc., 1995.

economy will gain from having more shareholders.[2] Similarly, mass privatization programs in which shares are offered to all citizens can also be politically more attractive and less controversial.[3]

Another question is whether competition through multiplicity in the electricity industry is always feasible. Competitive procurement of generation has been rendered possible by the choice of technology in a system dominated by thermal power plants (see Section 2.3.5) and by the existence of capacity usually in the order of several thousand megawatts. Is it possible to expect competition, for example, in an environment that is predominantly based on renewable technology (hydropower, for instance) as the primary resource? If so, will the rules of the game applicable to the United Kingdom, United States, or Chile be different from those applicable to, say, Brazil? Moreover, in 1990, there were 107 countries around the world with installed capacities less than 1,000 MW.[4] How would these issues, for example, be relevant to smaller countries contemplating power sector reform? To answer the first question, we take the case of Brazil where hydroelectricity makes up 91% of its total (52,646 MW) installed capacity.[5]

While the shape of reform of Brazil's power sector is yet to be finalized, there is a consensus among federal and state policy-makers and key operators that generation and supply should be separated from its monopoly segments—transmission and distribution—and awarded as concessions or sold to private investors. Unlike the cases of United Kingdom, the United States, or Chile, however, the rules for making competition

---

[2] *Ibid.*

[3] Three versions of mass privatization were observed in Eastern Europe and former Soviet Union. The first version, called 'rapid' case-by-case, was used in former East Germany. The second version used in Poland and Kazakhsthan was carried out with the help of intermediary mutual funds. The final kind was the voucher mass privatization used in the Czech and Slovak Federal Republic, Russia, Lithuania, Moldova, and Kyrgyzthan.

[4] In 1990, there were 60 countries with capacity less than 150 MW, thirty with capacity between 150 and 500 MW, and seventeen with between 500 and 1,000 MW. See Bacon, Robert, *Restructuring the Power Sector: The Case of Small Systems*, Industry and Energy Department, The World Bank, June 1994.

[5] This data from 1994 was available from the case study materials on *Brazil: Options for reforming the electricity sector* from the course, Infrastructure in Developing Countries, Department of Urban Planning and Studies, MIT, Fall 1996.

work in Brazil's proposed wholesale generation market need to address two major concerns:[6] First, the government must ensure open entry and the long-term viability of competition in the electricity sector by competitively allocating water rights. Without this provision, there is the possibility of the water-rights owner to appropriate rents of all downstream activities and, thus, create an entry barrier to competition.

Second, to provide incentives for investing in generating capacity, a pricing mechanism must be put in place that will ensure recovery of the high sunk capital costs characteristics of hydro systems. Intertemporal problems posed by water storage makes the use of conventional energy pricing at costs (or bid) of the marginal plant impractical.[7] One way of resolving this issue is to have two generation markets: a spot market, as in other power sector models, that would be used to trade energy and determine short-run marginal cost dispatch excluding fuel costs, and a contracts market where the hydro-based generators would recover capital and fuel costs and that would send the price signal for investment.[8]

The second question concerns the feasibility of introducing competition at the generation level in developing countries where the system capacity is small (less than 1000 MW). One argument against applying the principle of competitive bidding—through spot markets—in large power systems to small ones is that the repeated bidding mechanism is too complex for less-developed economies to administer. Proponents of this argument recommend the use of contracts instead.[9] But, if contracts—usually long-term in nature—are to be signed with existing or new generators the incentives for them to increase efficiency and reduce costs to gain market share would be less. Enforcing contracts to achieve economic efficiency would again demand strong administrative

---

[6] Estache, Antonio and Rodriguez-Pardina, Martin, *The real possibility of competitive generation markets in hydro system—The case of Brazil*, Public Policy for the Private Sector Note No. 106, The World Bank, February 1997.

[7] Using the pricing rules such as those used in Argentina, Chile, and the United Kingdom would result in highly volatile prices in Brazil, ranging from zero to the costs of unserved energy as the system swings between excess water and drought conditions. *Ibid.*

[8] *Ibid.*

[9] Contracts could be leases or concessions. Leases are usually of shorter durations compared to concessions.

capacity by the regulator, if not by a private independent entity. As establishment of viable financial markets and institutional capacity are prerequisites for both the above alternatives, it is up to individual governments to weigh them and chart out the appropriate policy roadmap.[10]

Another concern in small-scale power systems is the dearth of IPPs in the competitive procurement of generation. Too few players can lead to implicit collusion and gaming. The arrangement in England and Wales, with two large private generators, has already demonstrated that a large number of companies is required to induce truly competitive behavior.[11] Under such circumstances, the regulatory agency needs to ensure that the size and cost structure of the generating plants are similar, and that no barrier to entry exists for new IPPs. In countries where ownership of existing generation plants continues to reside with the state and only additional capacity is procured competitively, economic efficiency would dictate that the older plants also be subjected to commercial behavior. This may be achieved by awarding management contracts, to the highest bidding private entities, that allow for a performance-based regulation.[12]

Finally, for competitive procurement of generation to be effective, it becomes imperative to have excess generating capacity in the short run.[13] If all plants are needed on a regular basis, there is hardly any need for them to bid against each other. In developing countries where supply-side constraints lead to frequent load-shedding, it may be difficult to expect surplus capacity in the initial stages of IPP entry. It may, therefore, be necessary that IPPs be required to build additional capacities that, in aggregate, exceed

---

[10] In the long run, however, the financial markets would have to be matured and regulators be independent and competent.

[11] Bacon, Robert, *Restructuring the power sector: The case of small systems*, Industry and Energy Department, The World Bank, June 1994.

[12] The advantages of management contracts, however, should not be overestimated. In competitive markets, where privatization is relatively straightforward and political opposition can be overcome, outright sale is likely to generate more benefits than management contracts and without the costs of periodically renegotiating. See *Bureaucrats in Business: The Economics and Politics of Government Ownership*, A World Bank Policy Research Report, Oxford University Press, 1995.

[13] In a hypothetical world of perfect competition, there would be an infinite supply of generating capacity and each generator would be a price taker.

the annual load demand growth. From the perspective of maintaining system reliability, the excess capacity requirement, in effect, would act as a reserve margin.[14] The cost of reliability would, however, be reflected in the bid prices.

5.2 A Roadmap for Attracting Private Power Investors

Against this backdrop, the choice of technology and the size of electricity systems have important ramifications on a country's approach to restructuring its power sector. Unfortunately, experiences from developing countries that have applied the guiding economic principles of competitive private-sector participation to a technology setting quite different from, and to a system size that is only a fraction of those of, the "trail-blazers" may not be expected for some time to come.

Our second assumption was that private-sector financing—based on balance-sheet support—would provide cheaper and deeper capital in the long run. Once the restructuring and/or divestiture of a developing country's electricity infrastructure are in place, however, there is no assurance that corporate finance will be forthcoming. For example, newly privatized companies or IPPs owned by local investors and institutions are unlikely to have sufficient equity to finance expansion of their capacities. This usually implies that they would have to rely on international debt.[15] Access to international capital with no borrowing or repayment history makes it impossible, if not extremely difficult, for these companies to mortgage utility assets to secure payments. The

[14] System reliability does not, however, depend only on reserve margins. The crucial element in maintaining overall reliability is to have a regional coordination of transmission and distribution. This implies the need for some form of a central dispatch as discussed in the GridCo (UK) and NEPOOL (New England, USA) models in Section 2.3.4.

[15] We saw in Chapter 4 that budding local capital markets initially require considerable foreign capital flow through foreign direct investment and/or international debt to start the growth momentum and induce domestic savings to sustain that growth. But often, the lack of enthusiasm for local investors to channel their savings into private power is not infrastructure-specific at all. This problem can be traced to the country's macroeconomic instability characterized by domestic capital flight, exchange controls, and fiscal deficits that crowd out private investment. See *Lessons of Experience: Financing Private Infrastructure*, IFC, Washington, DC, 1996.

government sees no rationale in being the guarantor for this debt unless the state-owned utility itself is the sole customer of these IPPs. The questions developing country policy-makers, therefore, need to address are: What is the short-term approach to dealing with project financing which is still, more or less, the prevalent rule than exception? And what policy measures are to be taken to ensure a transition from project financing to corporate financing? We tackle each of these questions next.

The solution to handling project finance in the short-run appears to lie in the project developer's ability to finance country risk. As evidenced in Chapter 4, we found that the typical debt-equity ratio of today's project finance market in developing countries is 70:30. With this capital structure, private investors, to date, have been launching projects by requiring the host government to guarantee that the rules of the game be respected through specific support or implementation agreements.[16] Against this background, two outcomes are possible. First, countries carrying out power sector reforms will be extremely reluctant to meddle in a business that they are attempting to get out of.[17] Second, countries that are not carrying out reforms are not likely to abide by commercial principles of operation of its own power utility. These countries, therefore, have hardly any credibility to be guarantors of IPP debt.

Under both these circumstances, commercial lenders may have to resort to export credit agencies like, for example, the International Finance Corporation (IFC), Asian Overseas Private Investment Corp. (OPIC), and various Export-Import Banks for some form of risk cover. The IFC's syndicated loans (the B-loan program), in particular, appears to be a promising vehicle for cushioning lenders against country risk. The structure of these syndicate loans offer likely access to foreign exchange, a strong historical performance record, and regulatory benefits.[18] Since the first signing of its

---

[16] Bond, James, *Risk and private power—A role for the World Bank*, Private Sector FPD Note No.1, The World Bank, March 1994.

[17] Even where reforms do not allow for divestiture of existing utility assets but allow for commercialization within the given state-ownership structure, the government would not want to undermine its own utility's commercial principles by forcing it to purchase power from IPPs.

[18] Under a B-loan structure, IFC becomes the sole lender of record to the project, acting on behalf of both itself and participating banks. IFC is responsible for processing

syndicated loan of US$6 million for Chile's power generation in 1992, IFC has signed 17 such loans totaling US$937 millions in the power sector up an till 1996.[19] In some cases, IFC's mere presence as a debt cofinancier in private power projects can also eliminate need for syndicated loans for risk cover.[20]

At the end of the day, financial reforms would have to be implemented to move on from the short-term financing measures listed above. There are three principle reasons for carrying out these reforms in conjunction with, if not prior to, restructuring a country's infrastructure.[21] First, restructured or divested enterprises with high expected returns would require that the financial system allocate the necessary resources to them. Participants in the financial market evaluate firms, managers, sectors, and business trends in order to choose the most promising and creditworthy ventures. The better the financial system is at obtaining and processing information, the better the allocation of capital.

Second, there needs to be a capital market where savings from private individuals, banks, non-bank intermediaries, and other investment institutions can be channeled to service expansion of power utility infrastructure. Well-developed financial systems can both effectively mobilize savings and select promising firms to induce competition.

And finally, financial systems compel managers to act in the interests of those who hold claims against the firm, i.e., stock, bond, and debt-holders. Moreover, good corporate governance encourages more investment since investors and lenders feel more confident that firms will maximize owner profits and service debt obligations.

What are the elements of effective financial system reforms? Evidences from Chile, Korea, and Mexico suggest that reforms often proceeded in a two-track manner.

---

disbursements by participants, and for subsequent collection and distribution of loan payments received from the borrower. *Op Cit*, footnote 14, IFC.

[19] *Ibid.*

[20] In Nepal's first ever IFC-financed US$140 million private project, IFC provided senior and subordinated loans totaling US$31 million. The Norwegian aid agency, NORAD, is making a US$5 million loan and guaranteeing most of a US$29 million loan from Norway's export credit bank. This project is the first time that NORAD has provided financing for a project without requesting a government counter-guarantee. *Ibid.*

[21] Demirguc-Kunt, Asli, and Ross, Levine, *The financial system and public enterprise reform: Concepts and Cases*, Policy Research Working Paper 1319, The World Bank, Washington, DC, 1994.

Initially, governments took steps to enhance supervisory and regulatory capacity, cut back on directed credit programs, and reduced direct control of financial intermediaries.[22] Liberalizing interest rates, formulating legal codes for enforcing contracts, abolishing exchange controls, eliminating forced investment in government securities, removing restrictions on nonbank financial institutions were the typical reforms that characterized these countries. These were then followed by a reduction in the importance of state banks, bank privatization, and the strengthening of private financial intermediaries. Deregulating lending and deposit rates and opening up local capital markets to foreign participation were some examples of such reforms. Meanwhile, mixed and poor performing countries of financial system reforms have found to be unable to overcome a history of subservience to state direction.[23]

All said and done, a committed government needs to ensure that its power sector restructuring program is strengthened by a reformed financial system with the hope that the former will, in turn, deepen market capitalization and, thus, lend credibility to the country's financial system. Some key guidelines that may allow for this mutually enhancing relationship are as follows:[24]

First, in IPP prequalification under competitive bidding, the regulator may wish to give greater weight to those developers with businesses listed on a stock exchange and to those with well-capitalized balance sheets. With this regulatory predilection, the strategic goals of publicly held entities are likely to be more transparent and longer term because of these entities' obligations to public shareholders.

Second, project sponsors should be encouraged to use balance sheet support for subordinated debt and quasi-equity portions of the project financing plan in order to

[22] Chile in the early 1980s and Mexico in the mid-1990s liberalized their financial systems before a strong enough supervisory structure was in place, contributing to a financial crisis, but both moved promptly to correct the problem. *Op cit*, footnote 11, The World Bank Policy Research Report.

[23] Egypt, a mixed performer, continues to have 50% of the country's financial assets in its state-owned banks while India, a poor performer, has its state banks holding more than 90% of total banking assets. *Ibid.* demonstrate that

increase corporate financing. This strategy would ease the overall financing costs of projects and could be a transitional strategy for meeting the huge financing needs for IPPs in developing countries.

And finally, divestiture of commercially operating (and perhaps underperforming) generation plants by incumbent utilities to IPP developers should be made a possible policy alternative in the long run. These sales should be conditional on the purchaser's commitment to making specified investments. By making positive revenue streams available to IPP developers immediately, such transactions would give them the financial base to invest in multiple plants.

[24] Jechoutek, Karl G. and Lamech, Ranjit, *Private power financing—From project finance to corporate finance,* Private Sector Notes No. 56, The World Bank, October 1995

6. Appendix

Table 6 a: Country Data

Country	x_1	x_2	x_3	y_1	y_2	y_3	w_2	w_1	Z
Algeria	.	37	1.3753	91	1	1	4	1980	.
Argentina	126	35	0.636	90	8	4	2	2790	20
Bangladesh	.	38	.	87	2	3	3.75	220	.
Barbados	.	43	.	100	1	1	1	6630	.
Belize	.	52	.	100	1	1	1.25	2010	.
Benin	.	4	.	100	2	1	3.75	380	15.5
Bolivia	.	39	.	86	2	4	2.5	650	.
Botswana	14	.	1.8157	100	1	2	1.5	2530	7.1
Brazil	.	49	.	94	6	5	2.5	2940	.
Burkina Faso	56	30	7.9236	100	1	1	5.5	290	13.3
Burundi	.	36	.	100	1	1	6.5	210	.
C.Afr.Rep	.	25	.	100	1	1	5.5	1202	32
Cameroun	.	49	.	96	1	1	6	850	.
Cape Verde	.	59	.	71	10	2	3.75	750	.
Chile	.	47	.	80	4	6	2	2160	.
China	.	53	.	100	22	2	7	370	.
Colombia	.	43	.	95	8	3	3.25	1260	.
Congo	.	47	.	100	1	1	5.75	1120	.
Costarica	.	42	.	99	8	3	1	1850	.
Cyprus	.	50	.	98	1	1	2	8640	.
Djibouti	.	53	.	100	1	1	5.5	1034	.
Dominican rep	103	42	1.1666	65	1	1	2.5	940	36.3
Ecuador	.	35	.	100	20	3	2.25	1000	24
Egypt	.	35	0.9343	98	9	3	4.75	610	14.5
El Salvador	.	35	.	95	1	3	3.5	1080	.
Ethiopia	.	28	.	83	2	2	6.25	120	.
Fiji	.	27	.	85	1	1	5	1930	.
Gabon	.	37	.	100	1	1	3.75	3780	.
Gambia	.	60	.	93	1	1	2	360	.
Ghana	.	59	.	98	2	3	5.75	400	.
Guatemala	.	38	.	96	2	3	3.75	930	14.5
Guinea	26	34	2.9463	41	1	1	5.5	460	27
Guinea Bissau	.	43	.	91	8	2	5.5	180	.
Haiti	.	35	.	85	1	1	5.5	370	41.4
Honduras	114	43	2.3016	95	1	1	2.5	580	27
Hungary	.	53	.	97	15	5	2	2720	12.6
India	.	44	.	88	27	4	3	330	22
Indonesia	217	43	1.1825	70	4	1	5.5	610	20.4
Jamaica	176	43	0.6446	66	1	1	2	1160	19.2
Jordan	.	41	.	89	3	3	4.5	1050	16.6
Kenya	.	44	.	98	4	6	6	340	.
Korea	.	61	.	90	1	1	2.5	6330	5.6
Lao P.D.R.	.	43	1.642	100	1	1	6.5	220	16
Lesotho	.	.	.	0	1	1	5.25	580	.
Liberia	.	15	.	54	1	1	6.75	.	.
Madagascar	40	30	7.3374	86	1	1	4	210	17
Malawi	22	46	2.9013	92	1	1	6.5	230	14.1

Country	x_1	x_2	x_3	y_1	y_2	y_3	w_2	w_1	Z
Malaysia	.	53	.	91	3	2	4.5	2520	15.8
Mali	30	36	4.9022	93	2	2	5.25	280	.
Mauritania	.	16	.	100	1	1	6.5	510	.
Mauritius	122	30	2.2891	85	1	1	1.75	2410	12.8
Mexico	.	49	.	89	3	2	4	3030	.
Morocco	.	46	.	85	2	3	4.5	1030	.
Mozambique	.	2	.	95	2	1	5.5	80	.
Myanmar	.	25	.	75	1	1	7	.	.
Nepal	34	36	10.56	95	1	1	3.25	180	24
Nicaragua	.	30	.	87	1	1	3	460	.
Niger	38	30	7.25	100	1	1	5.5	300	.
Nigeria	.	28	.	99	1	1	4.75	340	30
Pakistan	.	54	.	83	2	2	4.25	400	.
Panama	.	35	.	93	2	1	3	2130	.
Papua New Guin.	.	42	.	45	1	6	2.5	830	.
Paraguay	.	52	.	100	1	1	3.25	1270	.
Peru	.	41	.	69	7	4	3.75	1020	.
Philippines	.	38	.	93	122	4	3	730	.
Poland	.	50	.	91	34	2	2	1790	15
Portugal	236	46	0.6366	92	121	1	1.25	5930	.
Romania	.	29	1.7045	92	1	1	5.25	1390	12.9
Rwanda	.	34	.	97	1	1	6	270	.
Sao Tome & Prin.	.	29	.	83	1	1	3.75	394	.
Senegal	.	37	.	98	1	1	3.5	720	.
Seychelles	.	40	.	100	1	1	6	5110	.
Sierra Leone	.	21	.	58	1	1	5.5	210	35
Solomon Islands	.	29	.	75	1	4	1	690	.
Somalia	.	21	.	100	1	1	7	.	.
Sri Lanka	.	30	.	100	2	3	4.5	500	.
St. Lucia	.	54	.	100	1	1	1.5	2492	.
St. Vincent & G.	.	42	.	100	1	1	1.5	1633	.
Sudan	.	30	.	70	1	1	7	1381	.
Swaziland	.	.	.	67	1	1	5.5	1050	10.4
Syria	.	37	.	77	1	1	7	1160	.
Tanzania	.	23	.	95	1	1	5.5	100	19.8
Thailand	.	56	.	90	3	3	3.75	1570	10.8
Togo	.	20	.	50	2	1	5.75	410	.
Tunisia	180	45	1.4386	97	1	1	4.75	1500	12.5
Turkey	.	40	.	93	1	1	3	1780	.
Uganda	.	55	.	96	1	1	5.75	170	.
Uruguay	.	45	.	95	1	1	1.5	2840	.
Venezuela	.	37	.	94	11	4	2	2730	.
Western Samoa	.	28	5.7447	90	1	1	2	960	.
Yemen Rep.	.	25	.	92	1	1	5.5	520	.
Yugoslavia	.	43	.	96	3	2	5	.	.
Zaire	.	25	.	78	1	1	5.75	.	.
Zambia	.	36	.	91	3	3	4	.	.
Zimbabwe	.	54	.	95	1	1	4.75	650	.

Legend:

x_1 = Customers per employee
x_2 = Generation capacity factor
x_3 = Employees per GWh produced
y_1 = % Publicly owned assets
y_2 = Magnitude of multiplicity
y_3 = Type of multiplicity
w_1 = Per capita GNP (surrogate for managerial capacity)
w_2 = GASTIL index rating (regulatory capacity and transparency of decision-making)
Z = Percentage system losses

Note: All the data are from 1991.

Table 6 b: Summary of Analysis Results (t-statistics) for 1991

Dep. Var'ble	Const.	y_1	y_2	y_3	w_1	w_2	x_1	x_2	x_3	R^2
Z	57.94	-0.2	-	-	-.009	-3.08	-	-	-0.56	0.72
	(11.27)	(-2.27)			(-3.09)	(-2.57)			(-0.96)	
x_1	158.22	-	47.14	-131.63	0.04	-	-	-	-5.61	0.75
	(3.99)		(3.86)	(-3.66)	(1.87)				(-1.22)	
x_2	51.59	-0.07	2.19	-3.46	-0.004	-1.32	-	-	-	0.20
	(7.40)	(-0.59)	(0.92)	(-0.61)	(-0.83)	(-0.73)				
x_3	-1.59	0.07	0.09	0.16	-0.003	-0.44	-	-	-	0.56
	(0.59)	(1.67)	(1.48)	(0.15)	(-2.18)	(-0.74)				

Table 6 c: Summary of Analysis Results (t-statistics) for 1988

Dep. Var'ble	Const.	y_1	y_2	y_3	w_1	w_2	x_1	x_2	x_3	R^2
Z	17.84	0.09	-	-	-0.005	0.08	-	-	-0.74	0.97
	(2.4)	(1.42)			(-2.40)	(7.45)			(-1.47)	
x_1	45.51	-	0.67	7.79	0.02	-	-	-	-0.47	0.27
	(3.33)		(1.88)	(1.46)	(1.54)				(-1.02)	
x_2	21.72	0.08	0.06	0.74	0.006	-0.007	-	-	-	0.40
	(2.68)	(0.86)	(0.71)	(0.61)	(2.55)	(-2.30)				
x_3	17.94	-0.12	-0.03	0.16	-0.003	0.002	-	-	-	0.84
	(2.68)	(-1.69)	(-0.38)	(0.15)	(-1.72)	(7.82)				

Instrumental Variables Estimation:

Table 6 d: Impact of Provision Structure on System Losses (1991)

$$z = \alpha + \beta_3 x_3 + \gamma_1 y_1 + \delta_1 w_1 + \delta_2 w_2 + \eta$$
$$x_3 = \alpha_3 + \gamma_{31} y_1 + \gamma_{32} y_2 + \gamma_{33} y_3 + \delta_{31} w_1 + \delta_{32} w_2 + \varepsilon_3$$

Dependent variable: z

Independent variable	Estimated coefficient	Standard error	t-statistics
One	57.94	5.14	11.27
y_1	-0.2	0.09	-2.27*
w_1	-0.009	0.003	-3.09***
w_2	-3.08	1.2	-2.57**
x_3	-0.56	0.58	-0.96

*significant at 0.1 level; **significant at 0.05 level; ***significant at 0.02 level
N = 13

Table 6 e: Impact of Provision Structure on System Losses (1988)

Independent variable	Estimated coefficient	Standard error	t-statistics
One	17.84	7.44	2.40
y_1	0.009	0.007	1.42
w_1	-0.001	0.0002	-2.40
w_2	0.01	0.001	7.45
x_3	-0.74	0.50	-1.47

N = 46

Table 6 f: Impact of Provision Structure on Customers Per Employees (1991)

$$x_1 = \alpha_1 + \beta_{13} x_3 + \gamma_{12} y_2 + \gamma_{13} y_3 + \delta_{11} w_1 + \varepsilon_1$$
$$x_3 = \alpha_3 + \beta_{31} x_1 + \beta_{32} x_2 + \gamma_{31} y_1 + \gamma_{32} y_2 + \gamma_{33} y_3 + \delta_{31} w_1 + \delta_{32} w_2 + \varepsilon_3$$

Dependent variable: x_1

Independent variable	Estimated coefficient	Standard error	t-statistics
One	158.22	39.67	3.99
y_2	47.14	12.21	3.86***
y_3	-131.63	35.98	-3.66***
w_1	0.04	0.02	1.87*
x_3	-5.61	4.62	-1.22

*significant at 0.1 level; ***significant at 0.01 level
N = 14

Table 6 g: Impact of Provision Structure on Customers Per Employees (1988)

Independent variable	Estimated coefficient	Standard error	t-statistics
One	47.51	14.27	3.33
y_2	0.67	0.35	1.88
y_3	7.79	5.34	1.46
w_1	0.01	0.001	1.54
x_3	-0.47	0.47	-1.02

N = 43

Table 6 h: Impact of Provision Structure on Generation Capacity Factor (1991)

$$x_2 = \alpha_2 + \gamma_{21}y_1 + \gamma_{22}y_2 + \gamma_{23}y_3 + \delta_{21}w_1 + \delta_{22}w_2 + \varepsilon_2$$

Dependent variable: x_2

Independent variable	Estimated coefficient	Standard error	t-statistics
One	51.59	6.97	7.40
y_1	-0.07	0.12	-0.59
y_2	2.19	2.38	0.92
y_3	-3.46	5.65	-0.61
w_1	-0.004	0.005	-0.83
w_2	-1.32	1.81	-0.73

N = 13

Table 6 i: Impact of Provision Structure on Generation Capacity Factor (1988)

Independent variable	Estimated coefficient	Standard error	t-statistics
One	21.73	8.10	2.68
y_1	0.008	0.009	0.86
y_2	0.006	0.009	0.71
y_3	7.74	1.20	0.61
w_1	0.001	0.0002	2.55
w_2	-0.001	0.0003	-2.30

N = 48

Table 6 j: Impact of Provision Structure on Employees Per GWh Produced (1991)

$x_3 = \alpha_3 + \gamma_{31}y_1 + \gamma_{32}y_2 + \gamma_{33}y_3 + \delta_{31}w_1 + \delta_{32}w_2 + \varepsilon_3$

Dependent variable: x_3

Independent variable	Estimated coefficient	Standard error	t-statistics
One	-1.59	2.66	0.59
y_1	0.07	0.05	1.67
y_2	0.09	0.06	1.48
y_3	0.16	1.06	0.15
w_1	-0.003	0.001	-2.18*
w_2	-0.44	0.59	-0.74

*significant at 0.1 level

N = 15

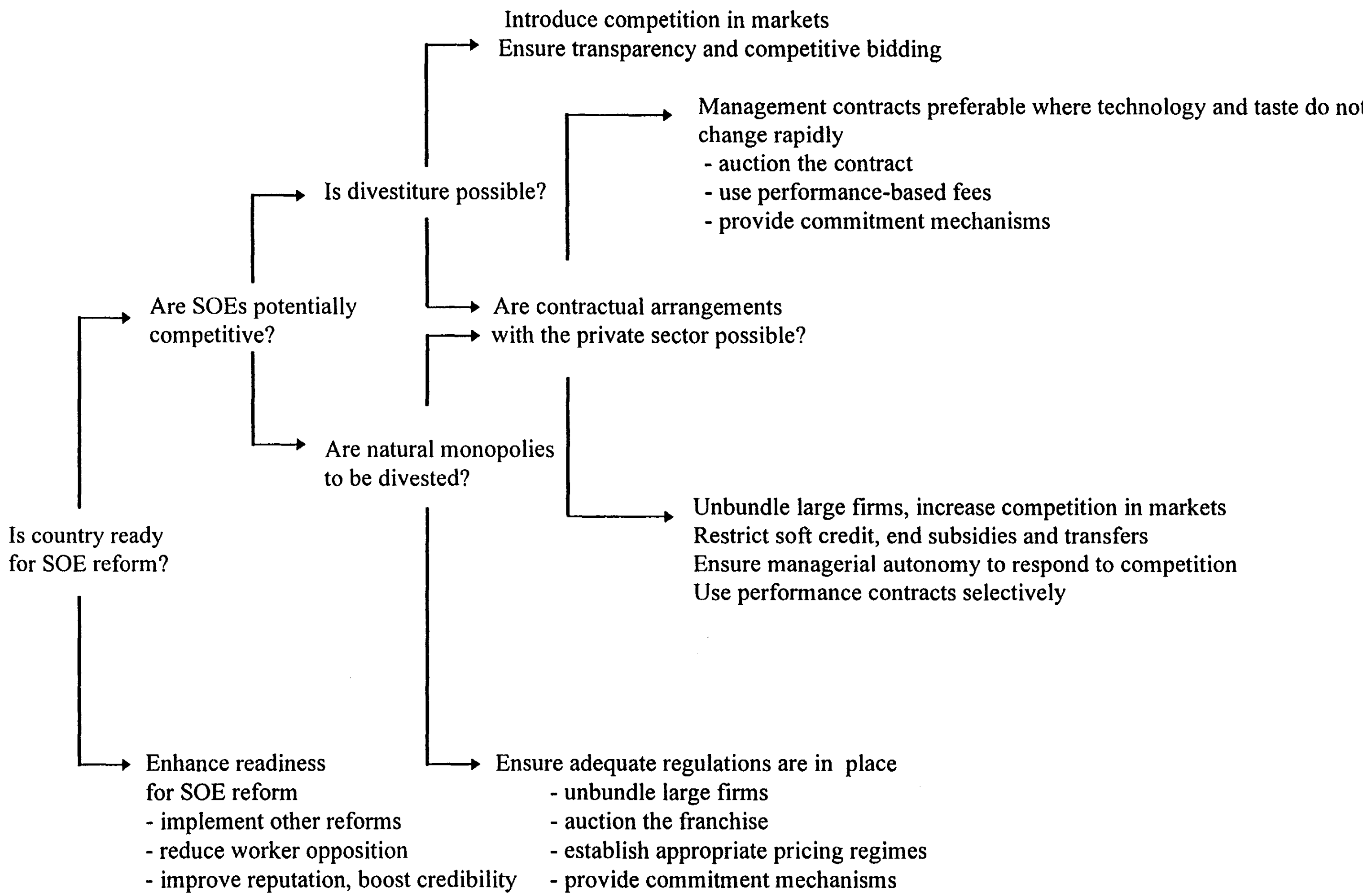
Table 6 k: Impact of Provision Structure on Employees Per GWh Produced (1988)

Independent variable	Estimated coefficient	Standard error	t-statistics
One	17.93	6.70	2.68
y_1	-0.12	0.007	-1.69
y_2	-0.003	0.007	-0.38
y_3	0.16	1.07	0.14
w_1	-0.0003	0.0002	-1.72
w_2	0.002	0.0003	7.83

Sources:

(1) Wu, Gary and Heidarian, Jamshid, *Power Sector Statistics for Developing Countries, 1987-1991*, Industry and Energy Department, The World Bank, December, 1994.
(2) *Energy Statistics Yearbook 1994*, United Nations, 1996.

Figure 6. 1: A Decision Tree for State-Owned Enterprise Reform



Source: *Bureaucrats in Business: The Economics and Politics of Government Ownership*, A World Bank Policy Research Report, Oxford University Press, 1995.

ACKNOWLEDGEMENTS

This thesis is dedicated to my parents who have laid tremendous faith in me and to the people of Nepal who have taught me humility and perseverance

I wish to express my deepest gratitude to the following people without whose guidance and cooperation this document of truth would not have materialized. I am intellectually indebted to Dr. Frannie Humplick whose Infrastructure in Developing Countries course at MIT's Department of Urban Studies and Planning inspired me to shape and develop my thesis under her guidance.

I am grateful to Dr. Richard Tabors who made every effort to ensure that I produced a Technology and Policy thesis and not a development report. I pray that dispassionate readers would bring in a favorable verdict.

I have also been a fortunate beneficiary of the vision and intellect of two mentors—Dipak Gyawali and Bikash Pandey—who inspired me to do energy policy research and, if favorable circumstances prevail, to make a living out it. I am glad that I followed Bikash Pandey's advice on applying to MIT's Technology and Policy Program.

I thank Gail, Linda, Jennifer, and Rene at the Technology and Policy Program for enlightening this ignorant soul by keeping me posted on the world inside of and outside MIT.

Lastly, if there were to be a best roommate award, I would strongly recommend candidacies of all of my six roommates at *Chhahari*. They preferred tolerance to expulsion with regards to my demands for house rules and organization. This, in effect, aided my academic pursuit.